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MUSCLE REEDUCATION IN THERAPY, INCLUDING ELECTRICAL STIMULATION OF MUSCLES AND NERVES *

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NEW YORK, N. Y.

Since the last war much attention has been concentrated on muscle reeducation. Analysis of a large series of cases of injuries to peripheral nerves and of poliomyelitis testifies to the efficiency of certain principles of treatment now established. The necessity of early protection from stretching and from the development of deformities is well recognized. Reeducational exercises such as free movements; assistive movements aided manually, by gravity or by the buoyant property of water, and resistive movements, represent an elaborate technic requiring much thought and special training for their accomplishment.

This discussion cannot attempt to give a complete outline of all factors playing a part in muscle reeducation. This would necessitate repeating facts well known to the physicians who are acquainted with the field. There are still, however, a great many questions in dispute. We will confine ourselves to a discussion of a few open questions and to underlining some points which in our minds need to be emphasized. We will consider only self-limited lesions of the lower motor neuron.

The field of muscle reeducation is comparatively young. It is usually only touched on in a general medical curriculum. The average physician has little knowledge of the exact details involved. However, as a large number of patients with peripheral nerve injuries are treated by the general practitioner and specialists other than physical therapy physicians, it seems our duty to spread the knowledge of its principles and technic.

A prerequisite for good results is technicians thoroughly trained in the methods of treating muscles and conscious of the many dangers involved in such treatment. The average physical therapy technician is not trained well enough so that he or she can be entrusted with a written prescription without the physician's going carefully into all details of the treatment. The wrong technic in executing a well prescribed plan of treatment is only too often responsible for unsatisfactory results.

The first step in muscle reeducation is accurate diagnosis of the lesion, its extent and prognosis. Electrical muscle testing, preferably chronaximetry, is sometimes the only means to distinguish between an upper and a lower motor neuron lesion or between a lower motor neuron lesion and a primary muscle disease or to diagnose an hysterical paralysis. Such evaluation is of utmost assistance in establishing a good plan of treatment. With regard to prognosis, we want to mention only one point. If the prognosis for life or for use of muscles is definitely bad, we will not trouble the patient with splints and other complicated procedures; but in all cases in which

* Read at the Twentieth Annual Session of the American Congress of Physical Therapy, Washington, D. C., September, 1941.

a bad prognosis is not evident, all the necessary prophylactic measures should be applied as early as possible.

The necessity of protecting paralyzed muscles from the sequence of loss of muscle tonus, of muscle imbalance with its dangers of contractions and fixed deformities and of fatigue and overstretching seems to be generally accepted and practiced by the specialist in physical therapy and by others who treat many patients with the type of lesion under discussion.[1] We all find that the application of these factors in routine practice is often fraught with innumerable and varied difficulties. In order to determine the points of danger for joint and muscle stretching and for possible contractures and deformities, careful and repeated muscle tests are needed; splints have to be applied, adjusted and altered as changed conditions of muscle balance require. For a general hospital this is not an easy task, and even in well supervised orthopedic hospitals a change in balance is often not detected and properly acted on in its incipient stage. Specific muscles can be tested and exercised only with the patient in certain positions. These positions might be harmful for other muscles. In each case the positions have to be specially worked out. Protective splints often have to be left on during testing and reeducation. This holds, of course, for all types of treatment connected with motion. Passive exercises are valuable to counteract contractures and to stimulate circulation, but if the principle of protection of weak muscles and stretched joint capsules is disregarded, passive exercises may do more harm than good.

The same thing is true for massage. The fibers of a muscle whose nerve supply has been injured are easily damaged by gross massage movements. The more superficial the fibers the greater the danger. Massage at first must be gentle, undamaging and directed toward keeping up nutrition. Later on, when muscles gain in volume and strength more stimulating movements may be gradually brought to bear.

Protection from fatigue in exercise practice proves to be one of the most difficult problems to solve. Often for long months only a small amount of exercise can be allowed at one session. On the other hand, in some cases the practice might be repeated several times daily, and this is often not possible in a busy physical therapy department. We solved the problem by substituting active reeducational exercises with muscle setting—which means teaching the patient to contract all weak muscle groups separately without moving a joint. To avoid fatigue, emphasis is placed on the patient's counting to five between each contraction. The number of such contractions is progressively increased.

Opinion is far from unanimous on the point at which weight bearing can be safely allowed. We feel that weight bearing is harmful as long as the muscles concerned with locomotion have not returned to at least a rating of "good." We have found that progressive improvement in the strength of the muscles concerned with weight bearing ceases if weight bearing is assumed when the muscles are evaluated at "fair" or less. In all cases weight bearing must be preceded by circulatory exercises of the lower extremities, support must be provided by ace bandages during early efforts at weight bearing and the progression of effort must be gradual. If a pool is available walking exercises may be begun earlier than we have indicated. In all cases of imbalance persistent weight bearing must not be attempted until proper braces and shoes have been fitted to augment the patient's efforts. In some cases orthopedic surgical intervention is necessary before balance can be achieved. These are the cases in which reeducational efforts have proved fruitless.

In patients with traumatic nerve injuries and in older patients continuous attempts at protection of weak muscles may result in the development of periarticular fibrosis, bone atrophy and joint stiffness. Adequate and careful passive movement is then indicated.

The importance of rest in the treatment of injured nerves is basic and generally agreed on. Each patient, however, presents an individual problem as to when and how functional activity is to be stimulated. A good functional end result is the ultimate goal.

Many ways of reeducating for function may be utilized. The possibilities and limitations of each technic are definite, and the closest attention in each case is necessary in order that progressive routines may be persistently carried out.

Voluntary contractions of muscles whose nerve supply is damaged can be accomplished even if only a small percentage of the nerve fibers are still responding to volition. These are usually managed by elimination of gravity and of friction, with the patient on a flat table or a wooden board or in a warm water tank. The fundamental principle of muscle reeducation with active function was laid down by MacKenzie[2] in his classic work published in 1918. This principle is that if more is asked from a weak muscle than it is capable of accomplishing it will be further weakened. If it is determined the exact amount the muscle can do without fatigue and this amount of effort is repeated without the development of fatigue, the muscle fiber will be stimulated and its capacity for work improved.

This approach is based on the conception that if a motor nerve supply to a muscle fiber is permanently interrupted no function can ever be expected from the muscle fiber. But in most instances of lower motor neuron damage, the damage does not remain permanent and complete. Nerve fibers regenerate, or they are damaged to a different degree, with all the intermediary stages from complete destruction to very slight damage. To sum up, every functioning muscle fiber, no matter how slightly it functions, must be permitted a chance to improve function. The training, however, must be consistent with the degree of damage present and always with fatigue eliminated.

Though these principles are in theory generally approved, they are often loosely applied. MacKenzie introduced small wooden treatment boards for use in addition to the horizontal treatment table to make possible the exact graduation of effort with assistance or resistance of gravity. Free movement on a plane surface enhances effort because of minimal frictional resistance. If the board is tilted so that the muscle being exercised is helped to carry out its function the exercise becomes assistive. If the board is tilted so that the muscle being exercised is impeded in its functional effort the exercise becomes resistive. So we utilize the inclined plane to graduate the resistance of gravity. Graduation of these three stages presents an extremely flexible method for a gradual decrease in assistance to a weak muscle and a means of delicately graduating the amount of work the muscle my be called on to do.

This treatment can be given in bed, is simple in its equipment and approach and gives an amount of detailed graduation not accomplished by any other method. The boards themselves are well known, but the exact technic, with gravity as the main measuring factor, is not widely enough used.

The treatment table introduced recently by Corbusier,[3] in which the play of gravity is replaced by resistance or assistance of different weights and the movements are performed on roller skates, is ingenious though more complicated than the simple board.

Much has been said about the benefits and advantages of underwater treatment. Its limitations have also been emphasized.[4] The retraining of individual muscles or of small muscle groups under water requires elaborate precautions for fixation of the whole body with the exception of the one muscle or the group of muscles one is attempting to improve. Often instead of the weakened muscle being exercised, substitution is augmented. Strong and often unaffected muscles may be hypertrophied unless special care is taken to prevent such an occurrence. If every effort is made to protect the muscles and to guard against fatigue, the mild relaxing heat, the elimination of gravity and the minimal friction of the exercise tanks, make underwater treatment an ideal medium for muscle reeducation.

Only those paralyzed patients should be accepted for underwater exercise whose involvement suggests the use of water as antigravity assistance and in whom stabilization underwater without the occurrence of substitution is possible. Just as important as the proper selection of patients for underwater therapy is the cessation of such therapy when the muscles can function with some resistance applied. The maximal and most rapid improvement follows when effort is stepped up as muscle function returns. In principle, muscles build up only by doing work and avoiding fatigue while so doing.

Underwater exercise can assume only a minor although a valuable position in the treatment of peripheral paralyses. Good work can be accomplished without it. As to the choice between a pool and an underwater tank, each has its advantages. Economically, a pool not only is expensive to install with regard to space, building costs and the cost of conditioning equipment but is not practicable to install except when provided for in the original building plans. The disadvantages of the underwater therapy tank are that only 1 patient can be accommodated at a time and therefore only about 8 a day. In many institutions this number would be sufficient provided the patients were selected carefully and underwater therapy not permitted beyond the point at which extreme assistance was no longer needed in treating the weakened muscles. A pool has the added advantages that it can be utilized for walking exercises, while a tank cannot.

We have not discussed underwater exercises for other orthopedic conditions, e. g. arthritis, various myopathies and myelitis, for which they may be utilized for increasing the available function, often through substitution. These conditions are beyond the scope of this paper.

We have made no reference to the use of heat in treating the paralytic state. The nervous regulatory mechanism of circulation is disturbed in peripheral paralysis. Nutrition depends on blood flow. Intrinsic warmth should be maintained at as high a level as possible. Therefore protective clothing, gloves, stockings and sufficient bed covers are essential to maintain temperature in paralyzed areas. Application of warmth in whirlpools or tanks or of heat from radiant sources should precede massage and exercise periods if possible. However, selection of the heat modality must be made consistent with the rulings elsewhere set down for protection.

Electric Currents in Stimulation of Muscle and Nerve

In discussing the electrical stimulation of paralyzed muscles we again find conflicting opinions.[5-6]

Reviewing experimental work done in this field, we find a situation as contradictory as the clinical claims. Langley and Kato,[7] and many others since, have demonstrated that a paralyzed muscle after section of its nerve develops autonomous, fibrillar, continuous, rhythmic contractions. These

start, depending on the experimental animal used, from the second to the sixth day and may continue according to Langley up to seventy-one days and according to Sarah Tower[1] until complete degeneration of the muscle—well over a year. This fibrillation is certainly different in its mechanism from a physiologic muscle contraction, but it seems also to stimulate circulation and metabolism, as shown by the higher oxygen consumption of a denervated muscle demonstrated by Ernst Fischer[8] and others and by the redder color observed only recently by Tower, Howe and Bodian.[9]

The old argument for using artificial stimulation of muscles which cannot contract voluntarily is that it is function which will preserve muscle structure intact until nerve regeneration takes place. If the paralyzed muscle is functioning automatically this argument may be a fallacy. If one also thinks of the "law of denervation" established by Cannon,[10] which states in general terms that a denervated organ, also a muscle, becomes hypersensitive to stimuli, one will be specially careful in applying such stimuli.

On the other hand, Langley and Kato[7] did notice diminished atrophy as measured by weight loss after stimulating with weak condensor currents. This finding has been confirmed by Soldant and Magladery[11] and especially Ernst Fischer.[8] It could not be confirmed by Chor[12] and his coworkers. Fischer found that the weight of the untreated side after one week corresponded to the weight of the treated side five weeks after denervation. His results were better when electrical stimulation was started immediately after nerve section than when it was delayed for two weeks. Fischer also stated that the power of contraction in the treated muscle was somewhat greater than in the nontreated muscle, though much less than would correspond to the small degree of atrophy. Fischer also found that the chronaxia became lengthened less quickly on the treated side than on the untreated side. These results seem to contradict Langley's original conception, that the atrophy observed in denervated muscles is an atrophy of exhaustion due to fibrillation.

This conception of exhaustion being taken as a basis, only very weak stimuli were used by Langley and by most investigators following him. On the other hand, Langley already has observed that weak currents applied through the skin will stimulate only the superficial fibers. Fischer, in trying to get a contraction of the whole muscle, used much stronger currents. This resulted in a delay of atrophy much more definite than that in Langley's series. We have to conclude from this that the dosage of current to be used is by no means established experimentally. If we also consider the present day discussion of the physiologic mechanism of nerve impulse on muscle, the still open question of whether this mechanism is a chemical or an electrical phenomenon[13,14] and, further, the still unsettled function of the motor and plate end we cannot concede that definite conclusions based on experiments can as yet be drawn. We will, therefore, still have to rely on our clinical impressions. The majority of authors are inclined to be in favor of the use of careful electrical stimulation. In its application, all the principles governing muscle reeducation have to be carefully applied. A well trained technician, good apparatus and careful adaptation of technic and modalities to the changing muscle status are essential.

It is our feeling from clinical experience that the major importance of electrical stimulation of muscles is that contractions of muscles by any means promotes circulatory blood flow. This electrical stimulation in the case of paralyzed muscles can be given in the face of muscle protection if the intensity of the contraction is kept below a point at which joint movement

is produced. This would be likened to the muscle exercise produced when muscle setting is undertaken.

A muscle which has been relatively inactive or inflamed has a tendency to the development of fibrosis with the formation of adhesions in the interfibrillar spaces. The formation of such adhesions may be inhibited by occasional contraction of these fibers produced electrically.

When the function of a muscle is lost for any length of time because of paralysis, pathways have to be reestablished between the central nervous system and the functioning muscle. Often the patient's ability to reconstruct such pathways is deficient though anatomic interruption in the pathway is no longer present. Electrical stimulation of individual muscles can be utilized to help the patient regain his muscle sense and so locate his muscles for muscle reeducation.

As stated elsewhere in this paper, muscle tissues do not build up in volume and strength except when called on to do increasing amounts of work. Cerebration as a primary part of volition apparently carries with it the factors governing trophic influences associated with growth.[15]

A large variety of methods of electrical stimulation are available. With the foregoing statements as a basis, we suggest the utilization of electrical stimulation in the treatment of paralysis as follows:

At certain stages in the course of peripheral paralysis we are governed in our selection of a current by the physiologic responses which can be induced. The faradic current in the treatment of peripheral paralysis has little to offer, because if faradic stimulation can be induced volition is already present, and we feel that as a means of exercising muscles voluntary efforts are of far more value than artificially induced contractions.

In the stage of paralysis in which it is possible to produce galvanic motor point contractions, we feel that such contractions are of value in assisting the patient to force through voluntary impulses by increasing awareness of the location of the peripheral muscle which he is attempting to contract. In our work we use the pole of the galvanic current which at a particular stage of paralysis gives the best contraction. In using electrical stimulation for treatment, we do not apply to a paralyzed muscle an amount of current greater than that which will just produce a visible contraction in the corresponding muscle of an unparalyzed part. In the case of a paralysis of both lower extremities, we select the amount of current by measuring the amount which will just produce a visible contraction of a muscle of practically similar volume elsewhere in the body.

In applying such electrical stimulation, we place the patient in a position in which the effects of gravity are minimized while the stimulation is given. Usually early in the treatment with motor point stimulation, no visible contractions, often no palpable contractions, are noted.

We do not wish to confuse muscle testing with therapy. In testing muscles we increase the strength of the current until contractions occur. Not so in therapy. Three or four contractions at an individual motor point represent the maximum number early in treatment, and we never increase the number beyond a dozen at each motor point and no increase is made over the original number of contractions until visible contractions are noted. This is consistent with the rules laid down as to avoidance of fatigue in muscle reeducation.

We have mentioned only motor point stimulation. We do not feel that rhythmic contractions in the treatment of paralysis are indicated except in those cases in which there has been a good return but in which we later find some fibrositis. In these cases, rhythmic currents may be of value in

loosening not too gross adhesions. To utilize these currents earlier in the disease for their effect on the fibrosis would carry with it the danger of overstimulation, deterent to muscle regeneration.

In the same category may be mentioned the use of the faradic current late in the treatment of the paralysis, and in overcoming adhesive processes sustained faradic contractions under manual control of the operator as available in the Morton Smart equipment have proved useful.

We must emphasize that extreme care should be exercised when electrical stimulation is used in the treatment of paralysis primarily to prevent fatigue and secondarily—a matter we have not yet mentioned—because if electrical stimulation is persisted in for too great a length of time a hypertonic condition of the muscle occurs, often with resulting spasticity. Any sign of spasticity developing during the treatment of paralysis by electrical stimulation should be regarded as cause for discontinuing such stimulation.

We have included in the scope of this paper electrical stimulation as a means of therapy. Most patients with peripheral paralysis can be treated by physical therapy without the use of any form of electricity, except that involved in heat generators and such currents as may be used for periodic electrical evaluation.

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ELECTRICAL AIDS IN DIAGNOSIS AND PROGNOSIS OF NERVE INJURIES *

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The problem of determining the extent of nerve injuries and recognizing the presence or absence of regeneration is frequently a difficult one. Decision as to the necessity of operation may rest on the detection of regeneration, and early accurate information on this point is therefore of great practical importance. In peripheral neuritis, facial nerve paralysis and other diseases of peripheral nerves a quantitative index of function, particularly excitability, is also desirable for prognostic purposes. The usual clinical tests for sensory loss, weakness, atrophy and vasomotor changes are of recognized importance in following the course of all nerve disorders, but there are occasions when a long period must elapse before conclusive evidence of regeneration is obtained in this manner. It has been found that sensory return commonly precedes clinical signs of motor regeneration in mixed nerve lesions, except for the radial nerve,[1] but sensation is not a reliable index of motor recovery.[2] In combined lesions, where there may be overlap of sensory areas, as with injuries of both radial and medial nerves, in facial nerve paralysis and in motor neuritis from various causes, the sensory tests are not helpful and other methods are necessary to evaluate nerve function. Occasionally in neuromuscular disorders, such as progressive muscular atrophy, muscular dystrophy and syringomyelia, special tests are desirable. Electrical examinations have been made in selected cases of these various types to obtain additional diagnostic and prognostic information.

The response of muscle to galvanic and faradic stimulation is the familiar test of electrical excitability. The reaction of degeneration as described by Erb[3] is a very approximate measurement of electrical excitability, however, in comparison with more recent studies. It has been shown that to obtain a muscle contraction the stimulating current must have a minimal strength (volts) and duration (milliseconds). This strength-duration relation is such that with increasing voltages less duration of stimulation is necessary and vice versa. A graph may be plotted of the intensity-time requirements of muscular electrical excitability known as a strength-duration (S-D) curve. Such a curve for a normal muscle is shown in figure 1*A*. When a motor nerve degenerates electrical excitability decreases and the change is reflected in the S-D curve, as illustrated by the upper curve in figure 1*A*. It can be seen that after degeneration greater voltages are required or longer duration of stimulation. This increase in either the time or the voltage parameter indicates decreased electrical excitability. Galvanic stimulation is of long duration at a minimal voltage (rheobase), while the faradic current consists of impulses of short duration. The voltage of the faradic current is not measured and is limited by the tolerance of the patient and the safe capacity of clinical machines, while the voltage of the galvanic current is usually only approximately noted. The galvanic-faradic responses of a muscle therefore refer to two roughly determined points on the S-D curve. When degeneration is present the explanation for the absence of faradic response is demon-

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strated by reference to the change in the S-D curve (fig. 1*A*), for the voltage tolerated is insufficient to cause a contraction with such short duration of each impulse. Chronaxie determination is the accurate observation of one arbitrary point on the S-D curve (the time required to produce a threshold contraction with a voltage of twice the rheobase), which is used as an index of excitability. To plot the whole S-D curve eight or more observations with varying intensity and duration are made, which seems a more reliable measure of electrical excitability.

Method

Selected cases of nerve injuries and peripheral neuropathies have been followed by repeated determination of the S-D curves. Muscle contractions were produced by condenser discharges, either a small bore hypodermic needle or a small metal disk with electrode paste being used for a stimulating electrode. A large dispersive electrode was attached to the opposite pole of the stimulating machine and placed symmetrically on the patient for a comparison of two extremities. End points were the first visible contractions of the muscle as indicated by movement of the needle or adjacent skin. The stimulator, designed by A. Grass, of the Harvard Medical School, produced currents varying in capacity from 10 to 0.0001 microfarads and in voltage up to 400. Shunt and series resistances were coupled to the patient's circuit to minimize the effect of varying skin resistances. Condensers of large capacity discharge over a longer period than those of smaller capacity, the relation of capacity to milliseconds being expressed by a simple mathematical formula (time = capacity × resistance). In this study, however, the capacity values were plotted against voltage logarithmically, as suggested by Hill[4] and Rosenblueth.[5] Observations were made in ascending and descending order with control readings on the opposite extremity when possible. In some instances electromyographic tracings were taken from the involved muscles, an ink-writing, three channel electroencephalographic machine in the brain wave laboratory of the Massachusetts General Hospital being used.

Results

A typical normal voltage capacity curve is shown in figure 1*B* for comparison with that obtained from a paralyzed muscle in a case of toxic neuronitis due to sulfamethylthiazole. The improvement in excitability as shown by the voltage capacity curves on later dates was the first evidence that regeneration was occurring. This indicated a hopeful prognosis, and complete recovery followed. Similar results were obtained in another case of the same causation, and again the electrical tests gave the first objective sign of improvement (fig. 1*C*).

The changes in electrical excitability during the course of recovery in a case of Bell's palsy are shown in figure 1*D*. The hyperexcitability to currents of long duration, giving the first electrical sign of improvement, is to be noted in the curve of the thirty-second day. This hyperexcitability corresponds to the abnormally active response to galvanic stimulation seen at times during the course of facial paralysis. The time relation of changes in galvanic-faradic reactions, S-D curves and function have been charted in table 1. Attention is drawn to the fact that the first sign of improvement was the simultaneous return of some voluntary function and of increased excitability as indicated by the S-D curve, while change in the galvanic reaction was not apparent till twelve days later and the faradic response did not appear for another two days.

Voltage capacity studies (fig. 2*A*) were valuable in the case of an infected stab wound of the upper arm which two weeks after the injury re-

TABLE 1. — *Comparison of Galvanic-Faradic Tests, Strength-Duration Curves and Function at Different Stages in a Case of Bell's Palsy.*

Time	Faradic	Galvanic	S-D Curve	Function
6th day	normal	normal	normal	0
16th	poor	normal	voltage up	0
27th	trace	ACC = CCC	voltage greater	0
32nd	trace	same	voltage less	trace
44th	trace	CCC > ACC	improved	trace
46th	fair	same	improved	trace

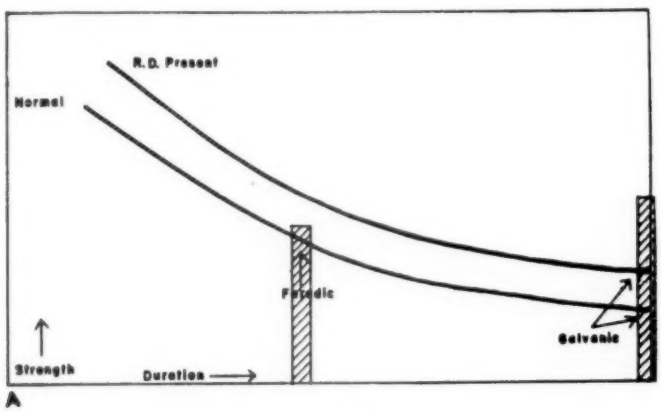

Fig. 1A.

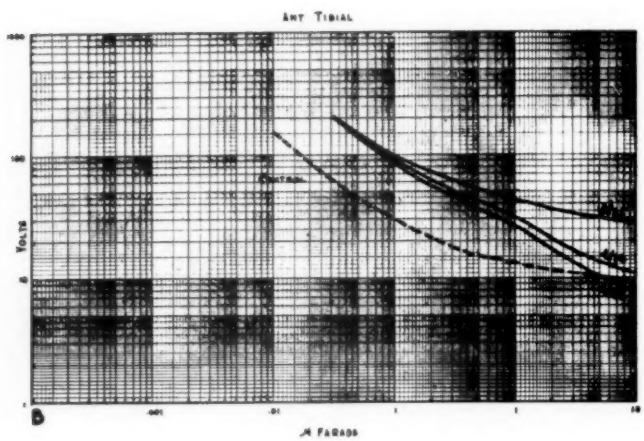

Fig. 1B.

quired operation for sudden hemorrhage. Postoperatively there was a median and radial nerve paralysis from either compression or severance, and it was not known if spontaneous regeneration would occur. The first sign of recovery was improvement in the voltage capacity curve, which led to cancellation of the proposed exploratory operation. Full regeneration occurred while the patient was receiving physical therapy.

Another electrical examination of value in the differential diagnosis of peripheral neuritis, progressive muscular atrophy or other disease of the spinal cord is the electromyogram. Surface leads with complete relaxation being used, no action potentials are visible in a tracing from a normal muscle (curve *A* in figure 2*C*). In progressive muscular atrophy, syringomyelia

and involvement of anterior horn cells from cord injury, diphasic spikes of irregular voltage and frequency may be found in visibly fibrillating muscles and frequently in muscle where fibrillation is not observed. These tracings have a rather characteristic appearance (curves *B*, *C* and *D* in figure 2*C*) and can usually be differentiated from the more continuous low voltage action potentials in peripheral nerve injuries (curve F), although these action potentials are difficult to obtain by this technic.

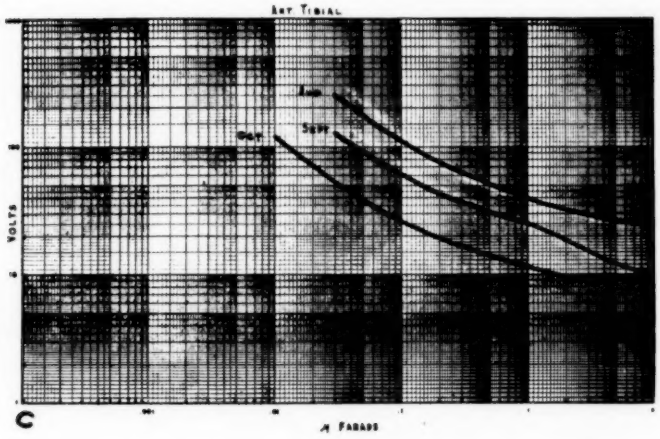

Fig. 1C.

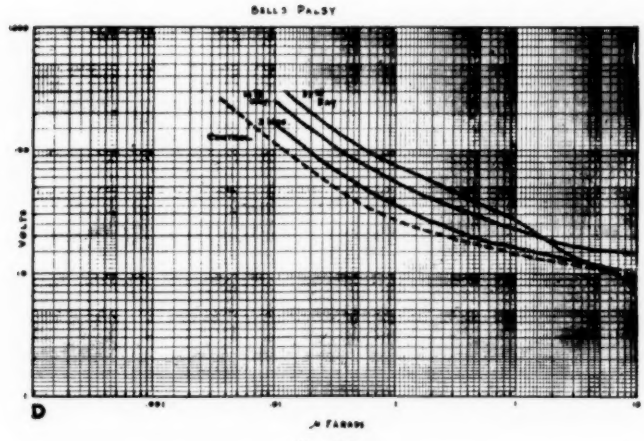

Fig. 1D.

FIG. 1. — *A*, diagram to show the relation of galvanic-faradic reactions to strength-duration curves in normal and denervated muscles when a reaction of degeneration is present. *B*, *C* and *D*, voltage capacity curves showing increasing excitability as an indication of regeneration in sulfamethylthiazole neuritis (*B* and *C*) and Bell's palsy (*D*).

The comparison between the electromyogram, the electrical excitability and the strength is of interest in the case of anterior poliomyelitis. Figure *2D* shows the electromyogram from the anterior tibialis muscle of a patient eight months after his attack of infantile paralysis involving both legs. At the time of the tests the strength of the muscles was graded as "zero" on the right and "poor" on the left. When contraction of the right anterior tibialis muscle was attempted no action potentials were visible, as shown in curve *A*; on the left low voltage spikes were obtained, as shown in curve *B*. A normal contraction is shown in curve *C*. The electrical excitability was markedly diminished on the right (fig. *2B*) and only moderately de-

creased on the left. The left leg improved steadily in excitability (lower line) and in function, whereas the right leg remained flail.

Comment

Measurement of the electrical excitability of muscle is difficult, and no uniform criterion is available. Conditions of stimulation vary so much that results from different clinics are not comparable without elaborate precautions. The shape of the S-D curves is known to vary with the type of electrodes,[6] position and polarity.[7] We have found, as did Rosenblueth and

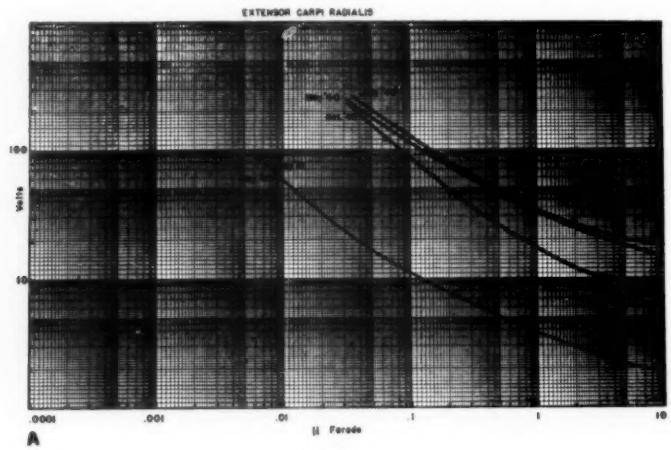

Fig. 2A.

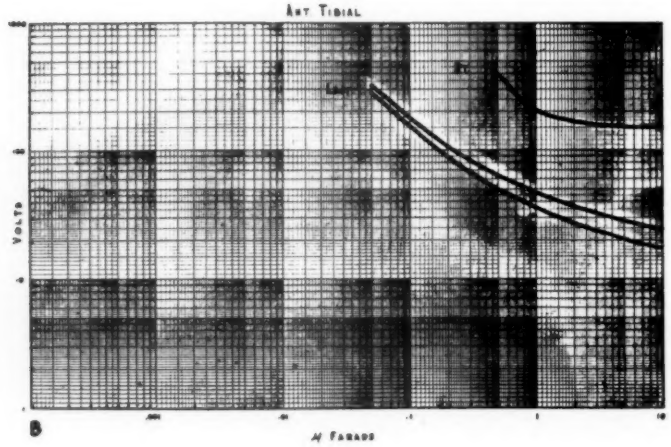

Fig. 2B.

Dempsey, that changes in the voltage paramenter are more marked and occur earlier than changes in the time parameter (chronaxie). Determination of several points on the S-D curve appears to give a more reliable index of excitability than a single observation, and we have accordingly used the more time-consuming technic. The first signs of regeneration may not appear for weeks or months with this test, as with the galvanic-faradic reactions, and in mixed nerve injuries the sensory return frequently precedes the electrical or functional improvement. This test, therefore, is not recommended for routine use but as an adjunct to other diagnostic examinations in selected cases.

Interpretation of electromyograms obtained with surface electrodes is difficult at times. Further studies will be necessary to explain the spontaneous electrical activity in muscles with degenerated nerve section and with progressive disease of the anterior horn cells. The present understanding of the problem has recently been summarized.[8] We have found the electromyograms valuable in the diagnosis of progressive disease of the anterior

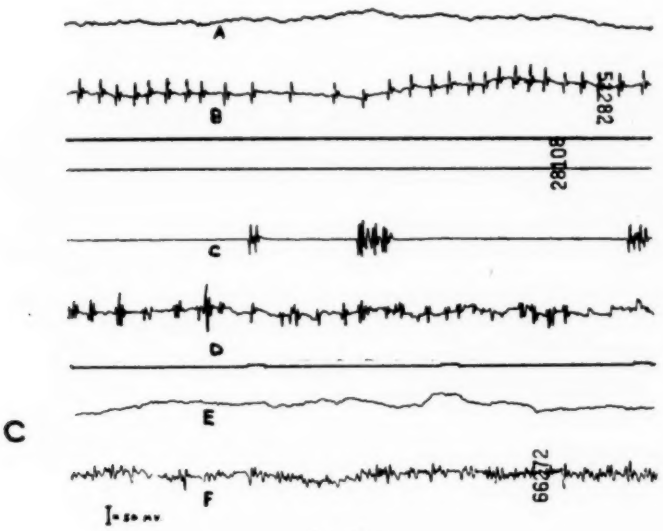

Fig. 2C.

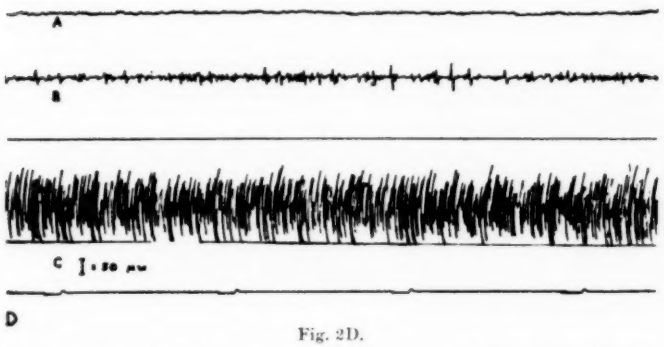

Fig. 2D.

Fig. 2. — Chart *A*, voltage capacity curves in a case of radial nerve injury. Curve *D*, normal control; also the return to normal of the affected muscle one year later. Curves *A*, *B* and *C*, the course of electrical excitability in the interim. Chart *B*, voltage capacity curves of affected muscles in a case of infantile paralysis. The right anterior tibial muscle corresponds to curve *A* in chart *D*, and the left, to curve *B* in chart *D*. The lowest line shows the improvement on the left one month later. Chart *C*, electromyograms. *A* and *E*, controls; *B*, progressive muscular atrophy. *C* and *D*, syringomyelia; *F*, ulnar nerve injury. Time intervals, one second (line below *D*). Chart *D*, electromyograms of attempted voluntary contraction of the muscles shown in chart *B*. *A*, paralyzed muscle; *B*, weak muscle; *C*, normal muscle. Time interval in seconds (lower line).

horn cells, and Schwab[9] has suggested a method of quantitating the fibrillation which appears to be of prognostic significance. The effect of regeneration on fibrillation of denervation has not yet been worked out. From a few observations it seems likely that the appearance of irregular diphasic spikes of much higher voltage than those characteristic of fibrillation may be an early sign of regeneration. The correlation found between tests for strength, determination of the electrical excitability and electromyograms

suggests that these methods of study may be of value in making a more accurate prognosis in cases of peripheral nerve disorders and also as objective measurements of the effectiveness of various physical therapeutic methods.

Summary

Tests revealing early signs of regeneration are of diagnostic and prognostic value in the case of nerve injuries. A method is described for quantitating electrical excitability by determination of strength-duration curves. In some instances the first evidence of regeneration in peripheral nerve disorders was detected by this means. Electromyograms from atrophied muscles were also of diagnostic importance and were correlated to other tests of nerve function.

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Discussion

Dr. G. J. P. Barger (Washington, D.C.): The continuing interest in the search for electrical aids in diagnosis and prognosis of nerve injuries is bound to be rewarded by increasingly reliable and helpful technics. The number of workers in this aspect of physical therapy seem to be relatively few compared to those working with other physical therapy technics. Dr. Watkins presents the use of both the condenser-discharge method, and the electromyograph method in determining the extent of nerve injuries and as a guide in determining whether or not there will be need of surgery and as a guide to functional efficiency and prognosis in a number of neuromuscular disorders.

Dr. Hansson and colleagues present the use of the electromyograph in muscle testing and grading in infantile paralysis and as a promising method in the general field of muscle testing. Both groups grade the condenser-discharge method and the electromyograph method as superior to the more widely used manual method according to Lovett's or Kendall's classification, and to the galvanic and faradic testing methods. Dr. Hansson and colleagues point out the problems yet to be overcome before the electromyograph method can be made available for general use. The condenser-discharge method by which the muscle chronaxie is measured is already commercially available for general use, so that refinements in the method of using this technic as presented by Dr. Watkins is indeed welcome.

My own work with the chronaximeter is barely beginning so that I have as yet no basis for original observations in its use. Doubtless the two less refined methods of muscle testing, or muscle grading, will continue for some time to be the mainstay of the majority of workers dealing with this special field, for several years must surely elapse before either of these two more refined technics can mass sufficient information and experience to preempt the field.

Dr. Watkins has added to the refinement of the condenser-discharge or chronaxie method, in the respect that instead of a single chronaxie reading he determines the full strength-duration curve by plotting some eight observations with varying intensity and duration, the readings being made in both the ascending and descending order. As I watch the efforts of research workers in many fields, I can but frequently marvel at the enormous unselfish effort, great expense, and large amount of time which is often dedicated to the addition of even one small increment of knowledge to the sum total

of our working collection. It is to be hoped that Dr. Watkins will continue his work in the application of both the condenser-discharge and electromyographic methods to muscle-nerve testing.

Dr. Arthur L. Watkins (closing): As to the question about the loss of faradic response in this case there was not the complete reaction of degeneration as there was a faint trace of faradic response at all times, but this did not improve until fourteen days after the return of function. There was not complete galvanic polarity reversal, but simply a change whereby the anode closing contracture was equal to the cathode and not complete reversal.

We have not attempted a complete study of the electromyographic tracings as Dr. Hansson and his associates have done. We have used it more as a diagnostic aid in certain types of atrophies to try to determine where the nerve lesion might be, whether peripheral, in the cord or higher up, or simply atrophy of disuse.

There was a calibration which I didn't mention for microvoltage, so that we could measure from these tracings the total amount of the microvoltage and study further the character of the curves, but we have not done it in the way that Dr. Hansson has.

I would like to state that we have not felt that this method, at least the excitability, has been developed to the point where it should supersede the usual functional tests for muscles in poliomyelitis. It is more useful for determining early changes in excitability before these same changes can be demonstrated by clinical methods.

OBSTETRICAL PARALYSIS *

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Since obstetrical paralysis is now believed to be the result of birth trauma to the brachial plexus, to the shoulder joint, or to both, a brief consideration of the anatomy of these parts is essential to any discussion of the condition. The brachial plexus derives its branches from the fifth, sixth, seventh, and eighth cervical roots and the first thoracic root. The junction of the fifth and sixth roots, where the suprascapular nerve emerges, is called Erb's point, and it is here that injury to the plexus most frequently takes place. Injury at this point may affect the nerve supply to such muscles as the deltoid, supraspinatus, infraspinatus, teres minor, brachialis and coracobrachialis. Erb's point is injured most often when, in delivery, the head is pulled to one side while the arm is still abducted or elevated. Traction on the head with the arms in this position may tear, stretch or traumatize the nerve group. The lower fibers of the nerve are injured if the arm is abducted; the upper fibers are injured if the arm is at the side.

To decide on the treatment, whether conservative or operative, and to give a correct prognosis, the primary cause of the paralysis must be considered. Most evidence[1] seems to prove that the palsy is of neurogenic origin and that changes in the shoulder, elbow and wrist are secondary to a nerve injury. Certainly the position of the arm—in internal rotation with pronation of the forearm and flexion of the elbow—the lack of resistance to passive motions and the usually negative roentgenograms bear out this theory.

But we must not overlook the fact that the upper humeral epiphysis can also be injured and, according to Scaglietti,[2] is injured more often than is thought. By a study of roentgenograms, Scaglietti tried to show that callus formation about the upper epiphysis is evident at 1 month and that the actual deformity, adduction and internal rotation, appears at about 3

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months. Thus one can see that if the future humeral head is posterior to the glenoid, the usual Erb regimen may not suffice and early operative intervention may be necessary.

Since the majority of patients with Erb's palsy will improve if proper therapy is carried out and since many will return to normal, the importance of early recognition and treatment is obvious. The presence of brachial palsy is evident soon after birth. Either the mother or the nurse observes that the baby does not use the upper extremity, that he cries when the arm is gently moved or that swelling or actual ecchymosis is present in the supraclavicular region. The complete flaccidity or lack of resistance to passive motion in the arm and the absence of any hypertonicity in the other extremities is usually enough to rule out infantile cerebral palsy.

Patients with Erb's palsy fall into one of three groups. If the fifth and sixth roots are involved, we generally speak of the upper arm type; if the inferior or seventh, eighth, and first roots are involved, we call it the lower arm, or Klumpke, type, and if the fifth, sixth, seventh, and eighth cervical roots and the first dorsal root are involved, we call it the total arm type. At first, however, it is impossible to estimate the actual amount of damage and to classify the palsy. This can be done only by noting the response to early treatment. If improvement results within a few weeks, the palsy may be said to belong to the upper arm type. The majority of patients with Erb's palsy fall into this group, and spontaneous recovery is usual.[5] If, however, after three or four months no improvement can be detected, it is certain that some permanent damage exists and that the palsy belongs either to the lower or to the total arm type.

Treatment

Treatment should be begun as soon as the condition is recognized. First, warm, wet heat is applied to soothe the peripheral neuritis which always occurs if the nerves have been stretched or torn. The pain usually subsides in one to fifteen days. When such an irritation is present, it is cruel to massage or stretch the arms or to give electrical treatments or make electrical tests. When the pain and neuritic symptoms have begun to disappear, the arm is tied to the head of the bed all night and for several hours each day. At this stage, a warm tub bath and gentle superficial massage soothe the patient and stimulate absorption of edema and hemorrhage. The arm, including fingers, elbow and shoulder, is put through a full range of motion daily. After about three to four weeks it is advisable to take a roentgenogram of the shoulder to learn whether there has been any epiphysial damage and to be sure that dislocation has not occurred.

This simple regimen is usually sufficient if carried out for about two to three months. By then the type of paralysis can fairly well be determined and a prognosis given.

Unless spontaneous recovery has occurred at about 3 months, as is often the case, the extremity should be properly splinted. The purpose of the splint is (1) to relax tension on the nerve plexus, (2) to take stress and strain off the involved muscle groups, (3) to prevent soft part contractures and (4) to avoid subluxation of the shoulder. To accomplish this, the brace must support the humerus in 80 degree abduction and full external rotation and must hold the scapula down and forwards, the forearm supinated, the wrist dorsiflexed and the fingers partially flexed. Unless the brace is easily applied, stays in place and holds the arm, it is useless. The simplest form of splint is plaster of Paris 2 inches wide, molded to

the arm and the side of the body. It holds well, can be changed as the infant grows and is inexpensive.

The two main complications to be guarded against when using a brace are edema and subluxation. The former is apt to occur when the brace or strap is too tight. It results in stiffness and joint fixation. The latter usually is caused by a brace which holds the arm in too great abduction and extension.

The brace should be removed two or three times a day, with removal followed by a warm bath and massage. The arm should then be put through a full range of motion, with an attempt to make the patient move it actively.

Visits to the physical therapeutist and physician during the following two or three years should be made regularly every two or three months unless a relapse is observed.

There are, however, many children who are not brought in for treatment before the age of 4 or 5. The program of treatment for these children is somewhat different than that for infants. We must first determine what the main disability is. Is it (1) muscle weakness secondary to nerve injury at birth, (2) bony deformity from primary joint trauma and nerve lesion or (3) muscle and soft part contractures as a result of position? If muscular weakness alone is present, plaster can be applied for four to six weeks as a means of resting the arm before physical therapy is begun. If, however, there is a bony deformity or soft part fixation, an operation is necessary before physical therapy can be beneficial.

The main points in the application of physical therapy for older children are briefly the following:

1. Treatments are given at least three times a week for two months, after which the parents are capable of supervising the exercises at home.

2. Gentle relaxation is induced by the application of radiant heat and light massage. Exercises are then begun, preferably with the patient sitting by a table. These consist of stretching and especially of active use of the muscles producing abduction, external rotation of the upper arm, supination and extension of the forearm and flexion and extension of the fingers. Resisted active motions are essential.

3. Motions should be limited to the shoulder joint, and care should be taken not to move the shoulder girdle. When the subscapularis muscle is tight, the scapula tends to tilt and motions are apt to take place in the girdle. We do not recommend the "hanging" exercises, since the main movement involved is in the scapula and not the shoulder joint. These exercises also tend to throw the rhomboid, trapezius and biceps muscles, etc., into marked tension and spasm without producing motion in them.

4. Strict attention should be paid to the posture of the patient. Because of the deformity and the attempt to compensate for it, the average patient with Erb's palsy stands with prominent abdomen, increased lordosis, elevated shoulder and scapula and forward stoop. Improvement in the use of the upper extremity tends to correct some of this static deformity, but a vicious habit may develop unless proper attention is paid to posture while one is working with the patients.

If after adequate treatment and supervision no improvement is noticed and the prognosis is doubtful, the reason for the failure of conservative treatment must be determined. From a review of our cases we have found the chief causes of failure to be:

1. Too severe a tear, such as an avulsion of the nerve roots from the cord.

2. Secondary changes, such as contracture of the pectoralis major or subscapularis muscle or of the joint capsule, which could not be stretched.

3. Bony changes which prevent proper usage. These changes are usually from a subluxation of the shoulder or elbow joint, a hooked acromial process, a projected coracoid process, a deformity of the humeral head secondary to epiphysial damage, a shallow glenoidal neck or a dislocated radial head.

4. Failure of parents and patients to cooperate with the physical therapeutist because of ignorance or indifference or for financial reasons.

Since spontaneous recovery frequently occurs in obstetrical paralysis and the prognosis with proper conservative early treatment is extraordinarily good, it follows that only a low percentage of patients ultimately require operation. As previously reported,[4] of 491 patients with Erb's palsy entering the clinic of the Hospital for the Relief of the Ruptured and Crippled in New York City from 1928 to 1939, only 44 were operated on. During the past forty years many types of operative procedures have been tried out. They can be classed under four general heads:

1. Exploration of the brachial plexus soon after birth with an attempt to repair any tears which may be found.
2. Correction of any existing deformity of either bone or soft parts or both at the shoulder, elbow, forearm or wrist.
3. Reenforcement of weak or paralyzed muscles by means of transplants of muscle or tendon.
4. Fusion of the shoulder joint.

We do not recommend operation on the plexus. As Ford[5] pointed out, if the paralysis is severe it is usually due to an avulsion of the roots from the spinal cord and operation can be of little use. Moreover, the procedure is difficult in a small infant, and the consent of the parents is hard to obtain in view of the fact that it is impossible always to give a good prognosis.

By far the most common of these operative procedures is the correcting of the existing deformity—usually an internally rotated, adducted humerus. For this condition a section of the rotators and adductors, the so-called Sever operation, is employed. Sever[6] recommended section of the pectoralis major muscle and of the subscapularis muscle outside the joint capsule and, if necessary, a subperiosteal section of the structures attached to the coracoid process, i. e., the coracobrachialis muscle and the short head of the biceps. We must not fail to note that the Sever operation does not increase the power of the upper extremity and does nothing to strengthen the weak or paralyzed muscle groups. Nevertheless, it improves the appearance of the arm, and to many patients the appearance of the arm is as large a factor as its use. The best results from the Sever operation are obtained:

1. When there is no subluxation or posterior torsion of the humeral head.
2. When there are marked soft part contractures and a trace of power can be detected in the external rotators and in the deltoid muscle.
3. When there is no prominent bony deformity such as an elongated acromial process or a hooked coracoid process. If these are present, osteotomy of each must be done at the time of operation.
4. When the operation is not performed until the age of 7 or 8.

Osteotomy, usually about 2 inches below the neck of the humerus, is an old method of relieving the adducted, internally rotated arm. It does not improve the function of the arm but does aid its appearance. However, it is an almost necessary operation if there has been a primary joint trauma resulting in an epiphysial injury and posterior displacement.

The most satisfactory treatment for older children needing operation consists of correction of the existing deformity followed later by a muscle transplant, the good or normal muscles being employed to aid the weak or paralyzed group. But each operative transplantation has certain prerequisites on which its success depends. It is not useful in all cases. For instance, before a trapezius muscle is transplanted, good trapezius, serratus and coracobrachialis muscles are necessary;[7] also, subluxation of the humeral head must not be present.

Many surgeons still consider arthrodesis of the shoulder joint to be the only operation resulting in a uniformly satisfactory arm in older children. We agree that good results may be obtained from fusion of the shoulder joint, but we reserve this operation exclusively for cases in which other procedures have failed.

From a study of a fairly large group of cases of obstetrical paralysis in which the various types of operative procedures were done, we can say that the final results depend on the efficiency of the postoperative treatment, operative technic being equal. In the cases in which there were improper splinting, poor follow-up and essentially no physical therapy, the results were extremely poor, but when the after-care was proper, the results were excellent. I want, therefore, to present a few conclusions regarding postoperative care.

Conclusions

Adequate splinting of the extremity in plaster is essential for at least two but preferably for four weeks. At the end of four weeks the spica is bivalved and baking and gentle massage in the plaster are given for two or three days. As confidence is attained the arm is passively lowered to the side, the elbow flexed and extended and the whole arm rotated in and out. Do not be discouraged if good internal rotation does not come quickly, as in many cases, especially after the Sever operation, limited motion and a sense of stiffness may last for as long as a year.

When good passive motion has been obtained, active exercises, at first against gentle resistance, are started. Here again the sitting position with the arm supported on a table is recommended. Results may come quickly or may not be achieved for several months. Hard work and infinite patience on the part of the trainer is required.

The patient should not be allowed to go without a support, whether plaster or abduction brace, until he has an active contraction of existing muscles. For this reason it is impossible to set a fixed time for removing the plaster or support and care must be taken not to remove it too soon.

Visits to the physical therapy technician twice a week for three weeks, then once a week for one or two months and then every two weeks for six months are minimum requirements. Here again we are confronted with the attitude of the patient and the parent and the ability of each to learn. The greater their cooperation, the less often are visits necessary.

If at any time the patient seems to be losing headway, the arm should be placed in plaster in a position as near that of the immediate postoperative period as possible. Often two or three weeks in this position will prevent a deformity and will keep the patient from being discouraged.

Lastly, there is no substitute for active exercises, stretching and hard work. Electrical apparatus and queer devices only fool the patient and the physician.

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THE OPERATIVE TREATMENT OF THE LOWER EXTREMITY IN INFANTILE PARALYSIS *

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The purpose of this discussion is not to describe new operations or to give statistical results of old operations but to comment on and review the most commonly indicated operative procedures for the lower extremity which has become disabled as a result of infantile paralysis. A physical therapeutist well trained and experienced in muscle examinations and fully cognizant of muscle function should know as well as the orthopedic surgeon what types of operations are indicated to improve the usefulness of the affected part. Operations in many instances are entirely supplementary to physical therapy and never are to be considered until all nonoperative therapy has been completed.

The function of an extremity varies in direct proportion to the degree of motion in its joints. A joint is formed of bone and cartilage surrounded by synovial membrane and capsule and supported by ligaments, but a joint cannot function with these structures alone; power of motion must be supplied by the muscles. Muscles must function normally to enable the joints to function normally. The muscles are stimulated to act by impulses traveling along nerve pathways from centers in the spinal cord and brain. When there is a partial destruction of some of these nerve centers, as in infantile paralysis, the muscles dependent on these centers for stimuli are affected and may be partially or completely paralyzed. To provide effective treatment leading to the restoration of function in the extremity, both the physical therapeutist and the orthopedic

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surgeon must have an accurate understanding of the action of both the paralyzed and the unparalyzed muscles. The work of the physical therapeutist and the orthopedic surgeon should start simultaneously with the paralysis of the muscles and should continue until no further treatment is indicated.

The treatment of the first and second stages of the disease is not to be considered in this discussion, but only the operative therapy of the third, or chronic, stage. This usually starts two years after the onset of the disease.

When the physical therapeutist after months of care of the paralyzed muscles, decides that nothing is to be gained by further conservative treatment, the time has come for a decision to be made by the orthopedic surgeon regarding the advisability of an operative procedure to improve the usefulness of the part. If the lower extremity has not become too deformed, a brace can usually be constructed which will increase its function and stability. Braces, however, are awkward, often unsightly and uncomfortable, and do not always perform the purpose for which they are intended. However, in many instances, operations, especially those for the correction of a fixed deformity of the hip or knee, will enable a brace to function satisfactorily where it has not done so before.

More of the surgery in infantile paralysis is performed on the lower extremity than in the upper because (1) residual paralysis is more common, (2) the operations are more successful and (3) it is a weight-bearing extremity in which there is greater need for more perfect function.

The surgical treatment of infantile paralysis can be divided into three groups of operative procedures: (1) Those to correct deformity of long standing (in the future with proper treatment and care in the first and second stages, these operations may become less often necessary); (2) Those to improve muscle balance by the transplanting of muscles or tendons; and (3) Those to increase the stability of the joints in most instances by arthrodesis. For the lower extremity a fourth group should be added, namely, operations for the equalization of leg length.

1. Operations for the Correction of Deformity

(a) The Hip. — The most common deformity is a flexion contracture which results from the patient being allowed to sit or lie for prolonged periods with the hip flexed. When this contracture measures more than 45 degrees, weight bearing on the extremity is usually not practicable. The deformity is due to contractures of the tensor fasciae femoris, the iliopsoas tendon, the sartorius, and the rectus femoris. There is always an associated weakness of the extensor muscles of the hip, particularly the gluteus[4] maximus. This deformity can be corrected by stripping the tensor fasciae femoris and the associated flexors of the hip subperiosteally from the anterior superior spine to the anterior inferior spine and crest of the ilium downward for a distance of about 1½ inches. This is the Soutter operation. In the more severe cases and in many others it may be best to detach the anterior superior spine and the anterior two-thirds of the crest of the ilium along with the muscle insertions and to transplant this bone into the ilium at a lower level. This is the Campbell operation. Some believe that the latter procedure causes less shock. The essayist, however, has never observed shock associated with the Soutter procedure when the flexion is gradually reduced, and does not believe that the more difficult Campbell procedure is often necessary. In the milder contractures of the hip a simple division of the tensor fasciae femoris muscle below the hip, followed by manipulation and stretching, may be all that is necessary. A transverse section of the iliotibial band just above the knee may occasionally correct the deformity. This is the Yount operation.

Occasionally an incomplete or complete pathologic dislocation of the hip may be associated with infantile paralysis. The essayist has had little experi-

ence with these types of dislocations. A reduction of the dislocation followed by the creation of a large acetabular shelf above the head of the femur will often result in a stable hip after an immobilization period of six months and a gradual return to walking, aided by physical therapy. If for any reason this operation is contraindicated or if it fails to produce stability, arthrodesis of the hip is indicated. If possible the fusion operation should combine both the intra-articular technic of removing all of the cartilaginous surfaces of the joint and the extra-articular technic of placing a bone graft from the upper end of the femur across to the ilium.

(b) The Knee. — The correction of a flexion deformity of the knee is much more often indicated than is the correction of a flexion contracture of the hip. The deformity is of course a result of the contraction of the strong hamstring muscles which are ineffectively opposed by a weakened quadriceps group. In slight degrees of the deformity, adhesive traction applied to the lower leg may reduce the deformity. In the severe case, however, a posterior capsuloplasty is indicated. In this procedure an incision is made on the outside of the joint, the tight iliotibial band is incised transversely, the biceps femoris tendon may be lengthened if it is contracted, and the posterior portion of the capsule of the knee should be carefully stripped off from the femur subperiosteally and other tight bands or structures should be cut transversely. The essayist has experienced excellent results with this operation; however, he strongly recommends that, if the contracture is extreme, no attempt be made to secure complete extension of the knee at the time of operation. It is much safer to carry out the operative procedure as described and then to reduce the remainder of the flexion deformity with skeletal traction. This is best accomplished by placing a pin or wire through the lower end of the tibia to exert a pull down along the axis of the tibia, and placing a second wire through the head of the tibia to exert a force upward at a right angle to the axis of the tibia and so prevent a subluxation of the head of the tibia. This type of skeletal traction for the knee is both safe and very effective. Occasionally a simple division of the iliotibial band will be all that is necessary to reduce the deformity of a contracted knee. If due to the pull of the tensor fascia latae a knock-knee deformity develops, this may be corrected by supracondylar osteotomy.

For a back knee or genu recurvatum resulting from weakness of the hamstrings, it may be necessary to implant the patella into the upper end of the tibia with the knee slightly flexed. This creates a bone block which prevents the knee from hyperextending, and is known as the Campbell operation. An alternative method is the construction of a strong check ligament posteriorly from the periostum of the femur and the fascia lata, to prevent hyperextension. This is the Gill operation.

(c) The Ankle. — For foot drop, which is by far the commonest paralytic deformity of the lower extremity, an open lengthening of the tendo Achillis is usually indicated. However, in recent years many orthopedic surgeons have felt that this operation is unnecessary, especially in the milder cases, as the tendo Achillis can be stretched by wedged casts or by a spring ankle brace which exerts a constant dorsiflexor force on the ankle. After correction of the deformity has been secured by any of these methods, an ankle brace with a right angle stop joint should be used to prevent a recurrence.

If a rotation deformity of the lower leg has developed, it may be necessary to do an osteotomy of the tibia. This is best performed about 4 inches below the knee joint, and is usually of a transverse type. It should be done before any operative procedure on the foot or ankle is attempted.

2. Operations to Improve Muscle Balance

In the transplantation of a tendon, it is always important that the four following points be carefully observed: (1) Any deformity of a joint affected by the tendon transplantation should be corrected; (2) The tendon should always arise from a muscle with fair power; (3) The tendon should pass to its new insertion in a straight line preferably through subcutaneous fat or a tendon sheath; and (4) The tendon, if possible, should be inserted under slight tension directly into bone. It is important that there be six weeks of immobilization after a tendon transplant alone, and twelve weeks when, as in the foot, it is combined with an arthrodesis. After this, physical therapy consisting of muscle reeducation must be employed until power is present in the muscle of the transplanted tendon.

(a) The Hip. — For the swaying backward gait caused by a paralysis of the gluteus maximus muscle, two operative procedures have been recommended; (1) The Ober operation, in which the erector spinae muscles are freed from their lower attachment and a long strip of fascia lata is removed, sutured to them, passed over the paralyzed gluteus maximus muscle, and fixed into the femur at the insertion of the gluteus maximus; and (2) The Dickson operation, in which the origin of the tensor fasciae femoris muscle with its bony attachment is transplanted into the posterior superior spine and the adjacent portion of the posterior iliac crest.

For the unsightly gait caused by a paralysis of the gluteus medius, in which the patient sways to the paralyzed side, the Legg operation is sometimes performed. In this procedure the origin of the tensor fasciae femoris is transplanted posteriorly on the crest of the ilium to a point directly above the greater trochanter. The essayist has seen very few end-results of these operations about the hip, but they are being successfully performed in many clinics.

(b) The Knee. — The essayist is enthusiastic about transplantations of one or two of the hamstrings for improvement of quadriceps function. This procedure is most successful in the presence of good hip muscles. The biceps femoris tendon, when the muscle is powerful, is most often used for transplantation into the patella; however, if this muscle is not strong, the transplantation of the tendon of a good semitendinosus is often just as successful. Many surgeons prefer to transplant both biceps and semitendinosus into the patella. The sartorius and gracilis muscles are sometimes used as transplants but the results are not entirely satisfactory. Muscle reeducation should be started about the fourth week and continued for at least twelve months, during which time the extremity should be supported to prevent stretching of the transplanted muscle or muscles.

(c) The Foot and Ankle. — Tendon transplantation about the foot and ankle is most often combined with a subastragalar or triple arthrodesis of the foot. It is very seldom performed alone except in children under eight years of age. For a varus deformity, the tendon of the tibialis anticus muscle may be transplanted into the cuboid bone or the base of the third or fourth metatarsal. For a valgus deformity, one or more of the peroneal tendons may be transplanted into the scaphoid bone or the base of the first metatarsal. For a calcaneal deformity, transplantation of one or both of the peroneal tendons or the posterior tibial tendon into the os calcis or tendo Achillis very often improves the power of plantar flexion of the foot.

In the treatment of a severe claw foot deformity, very often the common extensor tendons of the toes and the long extensor of the great toe should be transplanted back into the bases of the metatarsals or into the scaphoid bone.

This operation, combined with a transverse osteotomy, is commonly used for severe claw foot. Its results are generally satisfactory.

3. Operations to Increase the Stability of Joints

This group of operations is undoubtedly the most useful of the various types of procedures which have been described. The restoration of stability to a flail joint may enable a patient to bear weight on an extremity which could not be so used before, or it may make possible the discard of a brace which was necessary previously for support.

(a) The Hip. — Arthrodesis of the hip may be indicated by the presence of constant pain on weight bearing and by instability. The operation as previously described is the author's choice. A shelf operation may be performed for instability when a stiff joint is not desired.

(b) The Knee. — The desirability of arthrodesing a flail knee joint has long been questioned. Many orthopedic surgeons believe that a well fitting brace with an adjustable lock joint at the knee is much preferable to a stiff joint; however, for adults and older children who wish to be free of apparatus and will not be inconvenienced by a stiff knee, and especially for males, the essayist believes a fused joint is preferable to a brace. A simple removal of the joint surfaces with an implantation of the patella with its cartilaginous surfaces removed into denuded areas anteriorly on the lower end of the femur and upper end of the tibia is the operative procedure of choice. The knee should be placed in from 10 to 30 degrees flexion and immobilized in plaster from 3 to 6 months.

(c) The Foot and Ankle. — Arthrodesis of the subastragalar and mediotarsal joints of the foot is probably the most common operation in the entire surgical treatment of disabilities of the lower extremity caused by infantile paralysis. This is because deformity of the foot is more common than any other type of deformity. These operations should never be advised before the age of seven or eight years, and in most instances the child should be at least ten years old.

The Hoke procedure or one of its modifications is most often performed; however, the Naughton Dunn, Ryerson, Steindler, Hibbs, Brewster, and Lambrinudi operations are all excellent. They can be performed for any type of paralytic deformity of the foot. The author prefers a modified Hoke operation consisting of removal of the joint surfaces between the astragalus and the scaphoid, the astragalus and the os calcis, and the os calcis and the cuboid. Sufficient bone is removed from the mediotarsal joints to allow the foot to be displaced back upon the astragalus. All bone chips removed are denuded of cartilage and placed in the open spaces between the raw bone surfaces. Recently the Lambrinudi operation has been discussed a great deal in this country. The object of the operation is the locking of the ankle joint when the astragalus is in full equinus, in which position a large wedge of bone is removed from the under surface of the astragalus and the upper surface of the os calcis with the base of the wedge directed forward. The anterior end of the astragalus is placed in a notch on the posterior inferior surface of the scaphoid, thus maintaining the equinus at the ankle. This operation, however, is more difficult to perform than most of the others.

For a calcaneal deformity the Whitman astragalectomy has been popular, but it is never indicated when an equinus or varus deformity is present.

The essayist's results in these foot stabilization operations have been generally excellent. Sufficient care must be given to placing the foot postoperatively in a little pronation, as a valgus foot is seldom if ever painful, but a varus foot may develop pain or weight-bearing. Immobilization in plaster should be continued for eight to ten weeks with a change of cast three weeks after operation.

Arthrodesis of the ankle is performed in some clinics. When this is properly done, an associated instability of the knee will be improved. The results, however, are not always satisfactory as regards comfort in walking. If the operation is done too early, growth changes will often result in faulty position of the joint, although one clinic reports that with proper operative care this should not occur.

Sometimes a bone block operation improves the final result of a foot arthrodesis, particularly in the equinus foot. In the Campbell bone block procedure, bone chips are placed on the raw surface of the posterior superior portion of the os calcis beneath the tendo Achillis and extending up to the lower margin of the tibia. When this transplanted bone becomes solid, it acts as a check to prevent foot drop. Gill has described another operation in which the posterior superior surface of the astragalus is elevated and held in its new position by the insertion of a small wedge of bone. For a calcaneal foot, Gill creates this type of bone block anteriorly to prevent excessive dorsiflexion. In many clinics very satisfactory results have been reported following these procedures, but in some they have been abandoned because of unsatisfactory end-results.

4. Operations for the Equalization of Leg Length

These operations have now been performed in this country over a sufficient number of years to enable a fair opinion to be placed on their value. The essayist feels that whether the long leg should be shortened or the short leg lengthened depends upon the individual experience of the surgeon and on which procedure he is best prepared to perform. He has had little or no experience with either procedure, but from observation believes that in the hands of the average surgeon the shortening of the long leg is the operation of choice. This opinion is concurred in by Abbott, who first described the leg lengthening operation. The essayist believes that osteotomizing the femur and allowing the fragments to override is the safest type of operative procedure as described by White.

The epiphyseal arrest operation, originally described by Phemister and modified by many other surgeons, is another method of producing an equalization of the leg length. It is not believed, however, that there is yet sufficient evidence to determine at what age the epiphyseal arrest should be performed or how extensive the operative procedure should be for this to be an absolutely safe operation.

Conclusions

1. Great care should be exercised in the selection of the proper operative procedure for the improvement of function in the lower extremity.

2. Often, notwithstanding extensive muscle tests and roentgenograms, the most valuable information influencing the choice of operative procedure can be gained by observing the patient walk and handle himself.

3. In this discussion there have been described the most generally accepted operative procedures.

4. The four operative procedures most often indicated and following which the results are most uniformly good are: (a) The Soutter fasciotomy for a hip flexion contracture; (b) A transplantation of one or more of the Hamstring muscles for a paralysis of the quadriceps; (c) A lengthening of the tendo Achillis for an equinus deformity; and (d) An arthrodesis of the foot for instability.

5. Poor results most often follow the operative procedures (a) in which hasty decisions have been made on patients who have not been adequately observed, and (b) in which there has been insufficient after-care.

6. In infantile paralysis it is important to delay an operative procedure on the lower extremity until the patient has obtained the proper age, size, and bony development. It must be remembered that growth continues to take place

until the adult years are reached and that this growth may often undo the good of an operation.

7. After operations, many patients are able to walk for the first time, and others who wore braces and stood on crutches are able to discard these supports.

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NOTE: Discussions will appear in a later issue. — ED.

STATIC MICROTRAUMA

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Microtrauma is the result of minute force applied internally or externally so that no lesion of living tissue, such as hemorrhage, exudation, destruction of cells or necrosis, is immediately evident. The sensory response is usually below the threshold of perception or exceeds it only slightly. Functional disorder beyond the unimportant sensory reaction does not take place.

The ability to overcome the innumerable microtraumas caused by the strain and stress of life and environment falls within the category of natural adaptation. The number of microtraumatic insults has been greatly increased by the multiplicity of occupational activities and by the speed and intensity of labor. On the other hand, today's way of living raises the limit of perception by frequent distraction of attention and by habit formation.

It is a basic characteristic of living substance to render acute microtraumas harmless, to restore normal conditions and to prevent untoward consequence. This fundamental attribute is a problem of physiology. The acute microtrauma does not leave any immediate pathologic sequelae and is, therefore, of little medical importance.

If microtrauma is of long duration or frequently repeated at short intervals (chronic intermittent microtrauma), it becomes more important. Rapid succession or long duration of the microtraumatic irritation shortens the necessary reparatory pause or prevents it entirely, the physiologic limit of tolerance being exceeded so that pathologic signs and symptoms appear.

There are mechanical, chemical, thermic, electric, biologic and other microtraumatas. In the following discussion only a single form of the large number of mechanical irritations is reviewed, namely, the static microtrauma. By this is meant the influence of increased or prolonged bearing of body weight on certain structures of the human skeleton.

Under normal conditions the pressure of the body weight on the compressible parts of the lower limbs and the spine cannot be considered traumatic. It is physiologic. The weight of an adult man, for instance, may be 75 Kg. When he is standing or walking, this superimposed weight will not influence the solid bony structure, but it does affect the compressible soft interposed parts, such as the articular cartilages, meniscuses and intervertebral disks. When the weight of the body rests on one leg, the articular cartilage of the head of the tibia (tibial condyle) has to bear about 90 per cent of the body weight. In the supposed case it is nearly 70 Kg. If it is assumed that the articular surface over the tibial condyles is about 35 sq. cm., the pressure of the body weight on these cartilages amounts to 2 Kg. per square centimeter, or 2 atmospheres of pressure. In contrast to this weight pressure, the maximal systolic blood pressure (125 mm. of mercury) is only 0.17 Kg. per square centimeter. The weight pressure on the articular cartilage amounts to nearly twelve times the systolic blood pressure. The systolic blood pressure is by far the most important motor of nutrition of cartilaginous tissue. In comparison with blood pressure, diffusion and osmosis play a lesser part, particularly under higher tissue pressure. It may therefore be taken for granted that as long as the body weight rests on the leg, the circulation of tissue fluid within the avascular cartilage stops completely (circulatory intermission, rheopause). It must be stressed

that additional pressure is given by the force of the strongly innervated muscle stabilizers during the aforementioned phase of the step.

The cartilaginous tissue remains unharmed under physiologic conditions, because the rheopause is normally of short duration. In every phase of the step, another area of the compressible cartilaginous structure is put under maximal pressure. The line of gravity changes with each position of the joint. Alternating action of the legs favors automatic regulation.

Other parts of the skeleton are subjected to a similar effect of pressure. In the hip joint, for example, the main weight-bearing part has the approximate surface of 26 sq. cm. This area in the example mentioned has to bear about 40 Kg. during the weight-bearing phase. The pressure is 1.55 Kg. per square centimeter, or nine times the systolic blood pressure. The intervertebral disks below and above the fifth lumbar vertebra, very near to the center of gravity, bear about half the body weight, 35 Kg. with a surface of 25 sq. cm.; this is, 1.4 Kg. per square centimeter, or about eight times the blood pressure. The disk below the fourth cervical vertebra, with an area of approximately 4 sq. cm., has to bear the weight of the head, about 4 Kg.; that is, 1 Kg. per square centimeter, or about six times the blood pressure.

In the spine, the minute automatic changes of shape regulate the proper equilibrium of compression and decompression in cartilages and disks. Such changes of shape occur with respiration and with motion of the limbs and the trunk. Under normal conditions no disorder of local tissue metabolism will arise.

The problem is different in prolonged quiet standing. Now the line of gravity moves only slightly or not at all. The local circulatory intermission is lengthened, and the flow of tissue fluids stops for a longer period. There is, of course, a compensatory physiologic regulation too, by spontaneous, almost invisible staggering, by weight bearing alternating on each extremity, so that the pressure areas are changed. The situation is more complicated when one is compelled to maintain the upright posture for a long time or when the muscles are maximally energized. This occurs in a great number of standing occupations and also in long-continued, rarely interrupted sitting. The rheopause becomes considerably prolonged.

Surgical experience shows that living tissue must not be deprived of its circulation for more than two hours as an average. Articular cartilage, in spite of its low metabolism, is a damageable structure. Prolonged rheopause means malnutrition of cartilage, accumulation of waste products and stimulation of new formation of functionally inferior connective tissue, with reduction of elastic fibers (fibrillation). Reference to the literature concerning this matter gives sufficient evidence of the close connection between circulatory disorders and the early stages of degenerative osteoarthritis.

The time factor is of particular significance. When the rheopause has exceeded a certain duration, automatic defense takes place. This defense consists of an unpleasant feeling of pressure and unrest, of slight pain and sometimes of stiffness in the overstrained joints and the adjacent muscles. This sensation forces a change of joint position or a cessation of weight bearing. The onset of the "corrective unrest" occurs earlier in sensitive, nervous persons than in vigorous persons. Mental concentration or diverted attention may delay this protective reaction. Patients subjected to excessive static microtraumas acquire relatively early the signs and symptoms of degenerative osteoarthritis.

Now we may consider the relation of chronic static microtraumas to a few special conditions.

Older age, obesity and endocrinologic changes involving the cartilage in the menopause increase considerably the sensitiveness of cartilage to prolonged weight bearing. It is probable that genetic factors, climate, nutrition, temper, manner and custom of working, etc., may also do this.

Major traumas, such as fractures into a joint, and traumatic effusions, may affect cartilage severely. The resulting incongruity of articular surface gives excessive pressure on weight bearing to a few circumscribed parts of the cartilage. The combined traumatic and static lesion causes the earlier development of osteoarthritis. Preexistent nontraumatic deformities, such as genu valgum or varum, coxa vara, lordosis, kyphosis and scoliosis, work in the same way.

Circulatory disorders of the weight-bearing parts (venous congestion, thrombosis and edema) cause malnutrition of the involved cartilages. Superimposed static microtraumas act in an analogous sense on these parts. Inflamed joints in general react unfavorably to any kind of trauma or microtrauma. On the other hand, the returning ability to bear weight is a symptom as well as a measure of improvement in the local condition.

Static microtrauma is of particular significance in industrial medicine. Every practitioner knows that the complaints of many policemen, soldiers, salesmen, cooks, waiters, factory workers, housewives, nurses, dentists, surgeons and many others are due to their occupations, which require long standing.

Certain sports expose the elastic tissue to a pressure far beyond the physiologic limit. Forced muscular strain increases the compression of such tissues (in the case of athletes, weight lifters, etc.). Some times the acceleration of the inclined plane may give such additional pressure (downhill skiing). The resulting precocious arthritic disorders have been described in detail in the literature.

Static microtrauma under certain circumstances affects bony tissue too, as in the numerous cases of so-called static deformities caused by delicacy of the bony structure or by decalcifying diseases (rickets, osteomalacia, inanition, etc.). Fracture-like bony changes, Looser's Umbauzonen, belong to this category, as do a number of other disease conditions of the legs and the spine.

The effect of static microtrauma can be prevented or mitigated. The following principal measures are recommended:

1. Regulation (shortening) of the rheopause by brief interruptions of continuous weight bearing, if and when possible, and by intercalated suitable motions or exercises.

2. Improvement of the local (arterial) blood supply by active hyperemia (diathermy, radiating heat), by reduction of concomitant venous congestion (muscular exercises, massage, vibration, elastic bandages) and by treatment of varicose veins.

3. Correction of static deformities such as pronated feet, knock knees, bow legs and kyphosis.

4. Treatment of other associated diseases changes of joints. Complete and thorough attention should be given even to minute injuries of joints and their neighboring structures (sprains, traumatic effusions, internal derangements, etc.).

5. Therapeutic measures for already existing signs and symptoms of degenerative osteoarthritis.

Summary

1. The pressure of body weight on the bearing parts of the articular cartilage, the meniscuses and the intervertebral disks exceeds by far the maximum blood pressure.

2. Automatic regulation prevents the weight-bearing tissues from being harmed by that pressure.

3. Long duration of weight pressure acts as a chronic static microtrauma and may lead to tissue change.

4. Workers in standing positions and often also those in sitting positions are especially exposed and show a tendency to precocious development of degenerative osteoarthritis.

Some prophylactic and therapeutic measures are recommended.

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ADMINISTRATION OF A PHYSICAL THERAPY DEPARTMENT *

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The hospital of today cannot be regarded as modern unless it is so equipped that the sick may benefit by the latest discoveries in scientific methods of cure. Developments in scientific medicine since the last World War have demonstrated that physical therapy has an assured place among the effective curative agents. Therefore, it is only fair to say that every hospital should have available means whereby disease and injuries can be treated by physical therapy agents.

The preliminary problems of a hospital administrator when considering the establishment of a department of physical therapy are:

1. What constitutes an adequate physical therapy service for this hospital?

2. What service will the department render for the patients' betterment, particularly the class of patients in this hospital?

3. Is the expenditure justifiable and will the sum spent give a return in service and financial income equal to or greater than the same sum spent for other departments in the hospital?

These questions must be answered differently for each hospital and can be answered only after a careful survey of the typical cases in each hospital and the attitude of the staff toward physical therapy. A general hospital with 100 surgical beds may support a large physical therapy department if the majority of the cases are traumatic and may have little use for a department if they are general surgical cases. A general hospital in Chicago had one of the largest physical therapy departments, but its staff moved to another hospital. Although the new staff did a large amount of traumatic work, they did most of the physical therapy in their offices and the hospital physical therapy diminished to almost nothing.

Therefore, there are many problems to consider before installing a physical therapy department, and it is advisable to start in a small way and gradually enlarge and round out the department to fit the hospital needs. One must not overdevelop one phase of the work at the expense of another. How often one sees an overemphasis on electrotherapy and hydrotherapy and forgets that it is necessary to use intelligently all the agents which will make for a healthy growth. Then again one sees the regimentation or factory type of department. Here all treatments are given definite time periods and in many instances the individual patient is treated like a machine. Such a plan places physical therapy on a mercenary basis. Each case is a problem in itself and should be studied carefully, and a clearcut picture should be established in the mind of the physical therapeutist as to just what the condition is on admission.

With these facts in mind it is most essential that a hospital superintendent obtain a physician competent in this field or select a physician from the men on his staff and have him properly trained. This physician should

* Presented as a Part of the Instruction Course at the Twentieth Annual Session of American Congress of Physical Therapy, Washington, D. C., September 5, 1941.

secure the services of a well trained physical therapy technician through the American Registry of Physical Therapy Technicians or the American Physiotherapy Association.

The first problem to confront the new director of physical therapy is a survey of his hospital. I shall be glad to assist in making such a survey on request.

As soon as this survey has been made, the director will have some idea as to what he needs. His first job then is to locate and arrange his space.

The department should be placed strategically for future expansion. It should not be placed in a basement; it should be easy of access by elevator from the wards and rooms, so that apparatus can be taken easily to the patient's bedside or to operating rooms. For outpatients it should be near the hospital entrance and easily accessible to staff physicians. For clinic patients a large space should be selected and divided into cubicles by wires stretched from wall to wall 7 feet above the floor, from which curtains 6 feet long should be suspended. Instead of curtains, steel or wallboard partitions 7 feet high may be used, or permanent walls may be put in. The rooms should be at least 9 by 9 feet or, better, 10 by 10 feet, and the cubicles should be 6 by 10 feet. The ceiling should be at least 10 feet high. Walls and ceiling should be of fireproof construction and kept perfectly clean. Each room should open into the main corridor and be wide enough to admit a wheel chair or cart, and a small, 30-inch corridor between rooms is helpful.

The location of treatment tables so that the patients will not have to face brilliant light from the windows, ceiling or walls is very important, as is the color of the walls, which are usually yellow, yellow-green or gray. If the space is divided by curtains, lockers or dressing space should be provided, but if there are permanent wall divisions a small clothes rack in each room is all that is necessary. For the waiting room only a few chairs are necessary, as all but new patients come by appointment.

Ventilation and proper air conditioning are important, as patients are undressed and in many instances exercising. Where patients are exposed the temperature of the room should be between 75 and 80 F. Hot water or steam heating with manual control of radiators to vary the temperature of the rooms is necessary.

The director's office should be easily accessible. The technician's desk should have a view of the inside corridor and be within hearing of the call system and in view of the patients' entrance. There should be a telephone on the technician's desk and a branch to the doctor's office with a buzzer call. There should be a patient's call system, as the technician is not always at the desk to see a lamp call system and calls must be answered quickly.

The technician's equipment should consist of medicine wall cabinets for drugs, electrodes, bandages, dressings, instruments, etc.; a steel or marble-topped table near a sink for the preparation of electrodes; a linen closet centrally located; an instrument sterilizer for the preparation of electrodes; a closet for uniforms, clothes and personal property; several sinks for the cleaning of hands and electrodes; a soiled linen chute, and covered waste pails. Toilet facilities should be provided, and if colonic irrigation is being done or there is a hydrotherapy unit the toilet must be easily accessible.

The floor covering should be soft, as the technicians are on their feet constantly and a hard concrete floor will soon cause foot strain. Linoleum or rubber composition is a most efficient covering. A concrete or tile floor is necessary in a hydrotherapy room. The floors should be kept dry, as a damp floor will act as a ground for the electric current.

The electric outlets should be in pairs if possible so that a direct and an alternating current are available to save the expense of converters on electrical apparatus. The connecting plugs for the two currents should so differ that it will be impossible to connect apparatus to the wrong circuit. There should be one set of outlets in each room. If there is only direct current, polarity plugs should be used.

There should be one window to each treatment room and two or more in the gymnasium, underwater room and occupational therapy units. There should be protection against drafts, screens and window sills high enough for privacy.

The lighting in each room should be indirect, and there should be protection from noise, especially where there are patients with infantile paralysis, peripheral nerve injuries and spastic paralysis. The treatment of these patients requires the entire attention of the patient and the technician.

Equipment and Supplies

No equipment should be bought unless it has been approved by the Council on Physical Therapy of the American Medical Association ("Apparatus Accepted"). Here, again, one should start in a small way, buying only that which is essential and in accord with the survey made.

A small physical therapy department can be started with equipment that can be made by hospital mechanics, such as treatment tables, a Hubbard tank, a whirlpool bath, an electric lamp baker and many pieces of exercise apparatus.

For the average hospital the expense exclusive of installation runs between $3,000 and $4,000. With the equipment provided one technician can treat from 10 to 15 private patients per day. However, for an ideal department the expense exclusive of installation would be from $12,000 to $15,000 and about 125 patients could be cared for in an eight hour day.

It is wise at this stage to secure a sinking fund out of earnings, in order that the department may not be hampered in the future when equipment becomes outdated and equipment of a more modern kind is necessary.

The question is often asked: Just what do you consider as essential equipment? The answer depends on the kind of hospital with which one is dealing.

For the average hospital just getting under way it is best to start with the following equipment:

For treatment rooms:

One radiant heat lamp, large; two infra-red lamps, large; three infra-red lamps, small; one long wave diathermy machine; two short wave machines of the electromagnetic induction type; one galvanic-sinusoidal generator; one faradic coil; one combination air and water cooled mercury vapor lamp; one Hubbard tank for underwater exercises; one extremity baker; one body baker; one whirlpool bath with mixing valve and thermometer control either stationary or portable, and one wax bath.

The tables for the rooms should be 6 feet and 6 inches long by 28 or 30 inches high and from 26 to 30 inches wide; they should be covered by a mattress and have a head rest at one end which can be elevated. There should be a small side table for cold cream, powder and alcohol. A small stool should be placed under the table to be used by the patient in getting on the table.

A room should be equipped like a small gymnasium, with a posture mirror, one set of parallel bars, one Sayre head sling, one set of pulleys and weights (preferably three way), one set of stall bars with a shoulder abduction ladder attached and one Knavel table for hand exercises.

For occupational therapy, if this is possible, there should be additional space allotted, and it should have the following equipment: one large four harness foot loom, with a 36 inch weaving width; one table loom, four harnesses with an 18 inch weaving width; one hook rug frame; one warping reel or board; three braid weaving frames of various sizes; one bicycle scroll saw (adult size, with interchangeable pedals, 4, 6 and 8 inch); one bicycle scroll saw (child size); three wood-working benches with vises, the heights being 32, 38 and 44 inches; one sturdy work table; one emery wheel for sharpening tools; one oil stone, and a complete set of tools and a tool cabinet.

In many hospitals it is possible to enlist the support of the women's board to maintain the occupational therapy department.

A hydrotherapy room may be of value in certain hospitals and should contain a sitz bath, an electric light cabinet (reclining type), one hydrotherapeutic or douche apparatus with wall control and showers, one warming cabinet and one continuous flow tub.

These are just essentials, and with them as a base one can build a department that will fit all the entire needs of the hospital being served.

As the physician in charge builds, there are certain hints which will be helpful to him and his technicians. Formulate a written plan of procedure.

1. Be sure that you have a very definite understanding relative to budget allottment and your salary. If one stars on a part time basis a salary allottment of from $50 to $150 per month with a definite understanding relative to the future should be made.

2. Be sure to have a definite understanding regarding the starting salary of all new technicians, their yearly raises and their salary limitations. This is only fair.

3. Make out a scale of prices and submit it to your superintendent and staff. Many hospitals differ as to prices, the scale depending on the location and the type of patients treated. Do not have a price series, as for example 20 per cent off for twelve treatments or 10 per cent off for six treatments. This tends to the mercenary side.

4. Make daily calls on all your patients. Try to make the rounds with the attending orthopedist or others on the staff who send many interesting patients.

5. Keep equipment checked carefully, and keep it in the best state of repair.

6. Establish a clinic to show what you have accomplished.

7. Be sure to find out just what the referring physician wishes; discuss the case with him if that is possible, and if the treatment coincides with the best interest of the patient and there are no contraindications go ahead. Be sure that the purpose of treatment is clearly understood.

8. Try to get on the staff meeting program at least once a year.

9. Promote research among the younger men. Clinical research is often promoted by asking the clinical director of a department to ask one of his associates to work with the physical therapy department on a problem and allowing the specialist in this department to be the senior author of the paper to be published and the director of the physical therapy department the junior author.

10. Meet with your staff of technicians once a month and keep them up to date.

11. Establish definite policies (e. g., technician's pay).

12. Keep careful records and progress notes. Have your technicians make records of progress and keep you informed regarding patients.

13. Promote teaching among —

(*a*) nurses in your hospital (most nurses' training schools have required courses in physical therapy) and among (*b*) interns in your hospital.

14. Some hospitals send out monthly bulletins about the latest developments in physical therapy.

15. Lend a helping hand to the staff whenever possible.

16. If possible associate yourself with a teaching institution and do your share of instruction in the field of physical therapy.

17. Try to get on the programs of the local, district and state societies in the field of physical therapy.

18. Publish papers in your field of an interesting and informative nature.

19. Establish a definite relation between the nursing staff and yourself.

20. Keep in touch with attending physicians by phone or by note regarding their cases.

21. Make careful written routines for all divisions of the department.

The Physical Therapy Department in the New Meyer Memorial Building

The physical therapy department of the Michael Reese Hospital is located in the new Meyer Memorial Building, occupying the first floor and a part of the basement. The Brace Shop is in the basement in close proximity to the therapeutic pool. The second floor is given over to regular hospital rooms.

On the first floor there are a number of treatment rooms, a gymnasium and adequate locker rooms and separate rooms set aside for rhythmic suction, fever therapy, hydrotherapy and colonic therapy. There is a therapeutic pool in the basement.

Underwater Gymnastics. — The equipment (fig. 1) consists of a therapeutic pool, treatment rooms and an observation unit, which are located in the basement.

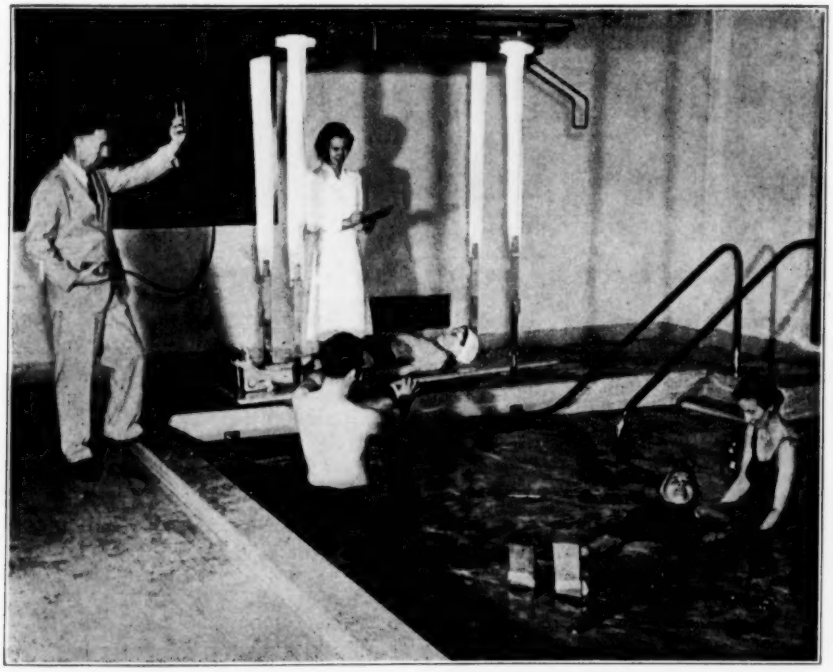

FIG. 1. — *Underwater Gymnastics.*

The therapeutic pool is 30 by 15 feet and is equipped with an electric hoist and overhead trolley and adequate accessories. There are a treatment and drying room with a shower booth alongside and an observation room for visitors.

All patients with infantile paralysis are given a complete muscle examination, which is repeated at definite intervals, in accord with the wishes of the attending physician. All patients are given a course of ultraviolet therapy.

The Hubbard Tank Room. — This is located on the first floor, and the equipment consists of a large Hubbard tank with a hand lift and a large treatment table. This tank is used for those patients who require higher water temperatures, such as patients with spastic paralysis, arthritis or early

FIG. 2. — *Corrective Gymnastics.*

poliomyelitis, and for very small children who might be fearful of the larger pool.

Corrective Gymnastics. — This division has a well equipped gymnasium (fig. 2) for corrective work. The gymnasium is 25 by 15 feet; is located on the first floor and is fully equipped.

As a routine, pictures are taken of all new patients and are followed up every month or two as the condition may require. A record of the patient's postural defects is kept on a special form, and a copy is sent to the physician. The check-ups are repeated at definite intervals in order to determine progress. All patients are, in addition, given infra-red radiation, massage and general ultraviolet radiation.

Fever Therapy. — Two rooms on the first floor are assigned to fever therapy. The equipment consists of two electromagnetic fever cabinets and one electromagnetic fever bag, together with all other equipment necessary

to meet any emergency. The personnel is well trained in this field, and the results of our fever treatment have been gratifying.

The types of patients whom we have been treating are those with syphilis of the central nervous system, symptomatic syphilis, gonococcic infections, arthritic conditions, chorea, asthma, ocular conditions such as iritis and scleritis, neuritis, Parkinson's syndrome and undulant fever.

Hydrotherapy.— Our hydrotherapy department consists of an especially equipped room with one large heat cabinet, a sitz bath, a complete douche table and showers.

In addition we have two stationary whirlpool baths located in other treatment rooms, contrast baths, a mobile paraffin bath unit and moist packs.

The outstanding effect of moist heat is the rapid vasodilatation in the capillaries and other superficial vessels. Moist heat may be applied with or without pressure effects.

The indications for hydrotherapy are fractures and sprains, especially recent fractures after removal of the cast, painful stumps, adherent scars, peripheral nerve injuries, indolent ulcers and many other conditions.

The sitz bath is used in cases of dysmenorrhea and pelvic pain, amenorrhea due to pelvic anemia, painful hemorrhoids and fistulas, hypertrophy of the prostate and acute retention of urine due to prostatic hypertrophy.

The wax dips are used for fractures of the bones of the wrist and hand, stiffness of joints, lacerations or infections, scar tissue restricting the motion of joints and tendons, chronic arthritis and tenosynovitis.

Electrosurgery. — There is a completely equipped room for minor electrosurgery, with an especially constructed table, an instrument cabinet, a sterilizer, a spotlight and an electrosurgical machine.

Minor electrosurgery is used for endocervicitis, small basal cell growths, benign growths, warts, moles, nevi and accessible fissures and for biopsies.

Rhythmic Suction Therapy. — One room is set aside for this therapy, and the equipment consists of two rhythmic suction machines, two small rhythmic constrictors and all necessary associated apparatus.

The term "pavaex" is often used in connection with this type of therapy and means "passive vascular exercise." This is a physical method used to assist after the major or secondary arteries have been obliterated by trauma or arterial disease in the prevention of serious sequellae by gradually dilating collateral arterial pathways by environment pressure changes in order to promote an adequate collateral circulation in the extremities.

It is used for major arterial occlusion, acute peripheral stasis following frostbite or freezing, predominant involvement of major arteries (such as arteriosclerosis obliterans and thromboarteritis obliterans), predominant involvement of secondary arteries, predominant involvement of arterioles and insufficiency due to secondary vasospasm.

Colonic Therapy. — Another room is equipped for this type of treatment. The apparatus consists of especially constructed Dierker machine. This is used for cleaning purposes previous to x-ray examination and rectal examination; in treating preoperative conditions; in postoperative treatment after colostomies, ileostomies, etc.; for stool examinations; for treatment of various types of atonic constipation, and in the preparation of patients for fever therapy.

Ultraviolet Therapy. — The department possesses lamps of the latest types for ultraviolet irradiation, both air cooled and water cooled. An extensive program in this field is conducted.

Electrodiagnosis. — Many cases have been tested electrically in the department of physical therapy for reaction of degeneration. The apparatus consists of the faradic coil and the galvanic machine. Reports are given or sent to the physician requesting such an examination.

Research. — The department conducts a research division. At present studies are being made on cases of infantile paralysis. This program is being financed through the National Foundation for Infantile Paralysis. Four beds in the hospital have been assigned for work of the National Foundation on infantile paralysis in the department of physical therapy.

Teaching. — The department conducts a teaching program for the nurses, internes, and students in physical therapy sent from Northwestern University for practical experience.

Occupational Therapy. — The department of occupational therapy, that is, especially the Curative Workshop and the general occupational therapy are under the direction of Dr. C. O. Molander. The pediatric and psychiatric occupational therapy are indirectly associated.

It is hoped that this article may assist those who are organizing a department of physical therapy, and may assist those who have problems which are difficult of solution.

TECHNICIANS EXAMINATIONS

Examinations for Registered Physical Therapy Technicians will be held during the latter part of February in Boston; and during the latter part of March in New York City. Further details and applications may be obtained by writing to the American Registry of Physical Therapy Technicians, 30 North Michigan Avenue, Chicago.

ARCHIVES of PHYSICAL THERAPY

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

.·. EDITORIALS .·.

OUR ALLIES IN BRITAIN

In the issue of the British Journal of Physical Medicine for December, 1941, appeared an extremely interesting editorial entitled, "Brothers in Arms." This editorial was written just as the United States of America entered "the great conflict for the things which are decent and right in the affairs of mankind." The editor stated, "we are nearer to America than ever we have been, and our hearts are sore for the sufferings which must be theirs before the war is happily ended."

We are happy to receive this message of felicitation from our colleagues across the sea. As we dig deeper into the task of fighting a good fight, it is encouraging to receive such a message. Now that we are actually embarked on our project and now that the suspense and uncertainty of the prewar period are passed, all of us are anxious to plunge into the struggle with the utmost vigor. There is a great deal for us to learn from the experiences of our allies, the British. Many physicians interested in physical therapy are now, or soon will be, in active military service. We must be prepared to perform whatever task our nation may require of us. The example set by our medical colleagues in Great Britain will be an inspiration to us.

A typical instance and an inspiring example of how to practice physical therapy at its best despite the handicaps of front line warfare is that which was set by Maj. W. S. C. Copeman, of the Royal Army Medical Corps. Members of the Congress of Physical Therapy will recall that Major Copeman was awarded the gold key of merit of the Congress in appreciation of the splendid work in physical therapy under most adverse conditions while he was with the British Expeditionary Force with Number 3 General Hospital during the first four months after Great Britain entered the present war. Major Copeman's article describing his work in this hospital, which was published in the "Journal of the Royal Army Medical Corps," should be read by every physical therapy physician in military service. His interest has been in the treatment of rheumatic diseases. Analysis of the total admissions to Number 3 General Hospital indicated that 15 per cent fell "into the rheumatic category" and that "26 per cent of all admissions in the medical division" could be listed as having rheumatic disease. Copeman pointed out that the necessary treatment, although comparatively simple, is not always available and may need improvising. He said, "Roughly speaking these cases, more particularly if they result from exposure, need rest, warmth, purgation, sweating—if possible followed by massage, and for a period a diet low in carbohydrates."

We wish that we might be able to illustrate in this editorial the remarkable pictures of the improvised physical therapy equipment employed by Copeman for treatment of his rheumatic patients: the heat cabinet improvised by placing towel rails on three sides of an ordinary canvas chair, the framework being covered with several layers of sacking, the patient wrapped in a blanket or towels sitting in this chair and being heated by steam led

under the sacking through a rubber tube attached to a large gasoline tin which is "boiling on a primus stove nearby"; or the improvised fever cabinet in which the patient lies on a hospital stretcher over which have been placed two bed cradles covered by blankets. The end of a piece of ordinary stove piping was then led into this hot air bath, the other end of the piping was placed over the flame of a "primus stove" or some other source of heat. Another interesting illustration was the picture of a crudely constructed but most efficient radiant heat lamp which was devised and used successfully at the hospital for several months, when electricity was not available. Copeman described the radiant heat or infra-red lamp as having been constructed from two gasoline tins with an additional sheet of metal behind them to act as a reflector. The source of the heat was a plate of cast iron or "a bundle of gas elements" placed over a primus stove and allowed to glow to a dull red. Copeman pointed out that "in this way infra-red as well as radiant heat waves are produced." Six of these home-made infra-red lamps were placed along a six foot table, the patients sat on a form in front of them, with the affected parts exposed to the radiation. One masseur was able to supervise the treatment of a large number of patients daily while attending to the necessary massage. It might be well for us to explain that a primus heater is a small single unit stove producing a very hot flame. This stove, supported by metal legs, is small and readily portable. It looks somewhat like the single unit electric hot plate but is, of course, non-electric.* Some of us may soon be forced to resort to similar improvisations. Let us hope that we can do so as efficiently as did Major Copeman. To our British allies let us say, "Thanks for your welcome, your sympathy and for the inspiration of your fine example. We are with you 100 per cent."

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1. Editorial: Brothers in Arms, Brit. J. Phys. Med. n.s. 4:167 (Dec.) 1941.
2. Copeman, W. S. C.: Notes on Treatment of the Rheumatic Diseases in the B. E. F., J. Roy. Army M. Corps 74:277 (May) 1940.

THE NEED FOR APPRENTICE PHYSICAL THERAPY AIDES FOR MILITARY SERVICE

Before war was declared, it was estimated that the Army was in need of 325 trained physical therapy technicians. These were to provide treatment in physical therapy under medical supervision for an army of a million and a quarter men. Now that war has been declared and an army of 3,400,000 men is contemplated, it is obvious that the needs for physical therapy technicians will be greatly increased. Already several of the members of the American Congress of Physical Therapy are heading training courses which have been arranged to meet the needs of our military hospitals. These emergency courses, which have been approved by the Council on Medical Education and Hospitals of the American Medical Association, last for a period of six months. At the end of this time, students who successfully complete the course qualify under the Civil Service Commission as Apprentice Physical Therapy Aides. They are then required to serve an additional six months' apprenticeship under the direction of a qualified physical therapy aide in one of the military hospitals. Once this apprenticeship is completed successfully, these persons can then qualify as regular physical therapy aides. Most of the civilian schools which are conducting such courses will accept

* The primus stove is similar to the camp stoves sold in this country with the exception that it burns kerosene instead of gasoline. We understand that this stove is manufactured in Sweden.

graduate nurses, graduates of approved schools of physical education or persons who have had two years of college training in a recognized academic college including courses in physics and biology. Nurses are now needed in the Army Nurse Corps and, for the most part, male students could be replaced by female students in order to permit the men to serve in other fields. Our approved schools for physical therapy technicians are having some difficulty in obtaining enough students to fill all of these courses. Only a few days ago the Civil Service Commission asked that each school increase its student body by ten or fifteen more students. It would seem to us that every physician and technician interested in physical therapy should urge young women who have been graduated in physical education and young women who have had two years of college including courses in physics and biology to volunteer at once to enter these schools and fill the vacancies at the earliest possible moment. Male students who can qualify and who have some physical disability which would not interfere with their practice of physical therapy but would prevent them from qualifying for active military service might also be urged to enter such courses. Graduate nurses are needed urgently elsewhere, now; and in most instances our able bodied male students can probably be more useful in some other phase of the war effort. Surely there should be enough persons in the categories which have been mentioned to fill our schools to overflowing if they were only advised of the need.

Won't you please do your part by spreading the news? The Council on Medical Education and Hospitals of the American Medical Association will be glad to supply any prospective student with a complete list of the schools which offer approved emergency courses.

THE NEED FOR PHYSICIANS TRAINED IN PHYSICAL THERAPY FOR THE ARMY

It is understood that, according to present plans, the Army Medical Corps will have 300 general hospitals. According to the present specifications for personnel in an army general hospital, there shall be seven physical therapy technicians (one chief physical therapy aide and six physical therapy aides) in each thousand-bed hospital.

To supervise the work of these physical therapy aides, a physician trained in physical therapy should be considered essential. Already about twenty army physical therapy physicians are on duty as directors of physical therapy departments in military hospitals. At the present time, the first group of ten army medical officers is being trained in a special three-month course in order to fit them to direct army physical therapy departments. The present training program will qualify between forty and fifty men a year. Reserve army medical officers can be trained in groups of twelve every three months. The group now under training will complete their work about April 1, and facilities for another dozen reserve medical officers interested in physical therapy will be available immediately thereafter.

Major F. B. Wakeman, Office of the Surgeon General, War Department, Washington, D. C., is anxious to obtain the names of reserve medical officers who are interested in physical therapy. In all probability, such men can be assigned to this special course for training and will then be sent to one of the army hospitals to assume charge of a physical therapy department. Every effort should be made to fill this need.

Dr. William D. Cutter

It comes as a great shock to all physicians interested in physical therapy to learn of the recent death of Dr. William D. Cutter (1878-1942), Secretary of the Council on Medical Education and Hospitals of the American Medical Association.

Doctor Cutter's passing will be a great loss to the cause of physical therapy. It was he who so ably supported the plans for development of various schools for training of physical therapy technicians and who co-operated so effectively with the American Congress of Physical Therapy in the establishment of the American Registry of Physical Therapy Technicians.

His quiet and capable administration of the problems of his Council have contributed tremendously to the advancement of medical education in this country. All who knew him admired and revered him. A great friend of physical therapy has passed from our midst. It is impossible to express in mere words the feeling of gratitude which the American Congress of Physical Therapy bore toward him. His exemplary career should serve as an inspiration to all of his successors. His like will not soon pass this way again.

MEDICAL NEWS

Dr. Solomon Called to Active Service

The central office has received word from Dr. Walter M. Solomon that he has been called to active service as a part of the Hospital Unit called from Western Reserve and the Lakeside Hospital, at Cleveland. Dr. Solomon, who is on the editorial board of the ARCHIVES, advises that he will be assigned to work where he can continue physical therapy. He will retain his work on the editorial board of the ARCHIVES.

Doctor McFarland to Los Angeles

Doctor Wayne McFarland, who has just completed a year's fellowship with the Mayo Foundation under the direction of Doctor Krusen, has returned to Los Angeles to connect with the College of Medical Evangelists in the Department of Physical Therapy at the White Memorial Hospital. He will assist in the teaching of physical therapy in the schools of medicine and physical therapy. His teaching and research study will be largely in the fields of therapeutic exercise and massage.

New York Physical Therapy Society

A meeting of the New York Physical Therapy Society will be held on Wednesday, February 4, 1942, at 8:30 p. m., at the New York Academy of Medicine, Fifth Avenue at 103rd Street, New York, at which the following program will be presented:

I. Scientific Session — Introduction: Colonel *Samuel J. Kopetzky*, President, Medical Society of New York State.

Papers of the evening —

1. "The Treatment of Injuries, Prevention of Disability and Rehabilitation of the Handicapped."

(a) Rear Admiral *Ross T. McIntire*, Surgeon General, U. S. Navy.

Discussion opened by *C. S. Stephenson*, Captain (MC) U. S. Navy, in Charge, Div. of Preventive Medicine.

(b) Lt. Colonel *George Koenig*, Chief of Surgical Service, at the Station Hospital, Fort Jay.

Discussion opened by *Charles R. Brooke*, M.D.

2. "Civilian Health Defense Program," *Henry Van Zile Hyde*, M.D., New York City — Regional Medical Director of Civilian Defense.

The Penna. Academy of Physical Medicine February Meeting

The regular February monthly meeting of The Penna. Academy of Physical Medicine will be held Thursday, February 19 at 9 p. m., at the Phila. County Medical Society Bldg., 21st and Spruce Streets.

The speaker of the evening will be *David M. Speaker*, B.A., B.S., Electrical Engineer, Research Laboratories of the Abington Memorial Hospital, and his subject will be "Principles of Electrotherapeutic Equipment."

Physical Therapy Committee, Indiana State Medical Association

The members of the Committee on Physical Therapy for the year 1942, for the Indiana State

Medical Association are: E. L. Libbert, *Chairman*, Lawrenceburg; H. W. Smelser, Connersville; A. P. Hauss, New Albany; N. H. Prentiss, Fort Wayne; Don Bowers, Indianapolis; Virgil McCarty, Princeton; W. W. Ayers, Hartford City.

Cease and Desist Orders

Abstracts of Certain Federal Trade Commission Releases.

New Twin-Arc Sun Lamp.—This was claimed by the Health Ray Manufacturing Company, Inc., Deep River, Conn., to provide "4 minutes light equivalent to one hour of sunshine"; to be safe and suitable for home use by laymen for treating diseases without the supervision of a physician; to help build strong bones and teeth, tone up the system, stimulate the glands, improve health and constitute a cure or remedy for athlete's foot, acne, pimples and surface eruptions of the skin. In March, 1941, the Federal Trade Commission ordered the Health Ray concern to discontinue these misrepresentations.

Omega Home Use Portable Machine and Mahler Electrolysis Apparatus.—These devices, also known as "Omega Method" and "Mahler Method," are promoted respectively by the Omega Manufacturing Company, Inc., (also called Omega Electrolysis Institute) New York, and the D. J. Mahler Company, Inc., East Providence, R. I. Both devices have been advertised to the public for the self treatment of superfluous hair. In June, 1941, the Federal Trade Commission ordered the Omega concern to cease representing that its device is painless, pleasant, quick or easy to use and will have no ill effects on the body. Further, it ordered the Mahler concern to cease representing that its device can be operated with ordinary skill and care. Under their respective orders these concerns were further directed to cease disseminating advertisements which fail to reveal that the use of their devices by persons not trained in the technic of removing superfluous hair from the body by electrolysis may result in permanent disfigurement or cause infections or irreparable injury to health and that these mechanisms should not be used to remove hair from cancerous or syphilitic lesions, pigmented moles or other areas showing local pathologic conditions. Each of the companies had previously been restrained by U. S. district courts on petition of the Commission from disseminating certain advertisements of their devices pending final disposition of the Commission's case against them. Incidentally the Commission, in July, 1938, had issued an earlier order against the Mahler firm, directing it to cease representing that its electrolysis device can be used safely by inexperienced operators for the removal of superfluous hair, dark freckles or other cutaneous blemishes.

Thermo-Magnetic Cushion.—The Chicago Thermo-Magnetic Cushion Company and its president, A. Mercer Parker, were ordered in March, 1941, by the Federal Trade Commission to cease and desist from certain misrepresentations in the sale of this device. Among these were that the thing constitutes a cure or remedy for constipation, colds, rheumatism, lumbago, sciatica, menstrual and nervous disorders and some other things; or that it has any value in treating such conditions beyond affording temporary relief from the pains accompanying such conditions when localized in an area affected by heat from such device. The respondents also were ordered to cease representing that the use of the "Cushion" will revitalize the human system. This device was declared fraudulent by the Post Office Department in December, 1938, and debarred from the mails. The case was discussed at some length in *The Journal*, Sept. 9, 1939, page 1051.—*(Reprinted with permission J. A. M. A.* **118**:*250 Jan. 17, 1942).*

Revocation of License to Practice Physiotherapy

The medical practice act of New York provides for the licensing of both physiotherapists and practitioners of medicine. The provisions of the act relating to the revocation, suspension ar annulment of licenses, however, refer only to practitioners of medicine. If "a physician has been convicted in a court of competent jurisdiction, either within or without this state, of a crime," disciplinary action is authorized. In 1930 the plaintiff was granted a license to practice physiotherapy in the state of New York; in 1936 the Regents of the University of the State of New York revoked that license on proof that the plaintiff had been convicted of a crime. From such action by the Board of Regents, the plaintiff appealed to the supreme court, special term, Ulster County, New York.

The plaintiff contended that the disciplinary provisions of the medical practice act had no relation to physiotherapists, but were applicable only to practitioners of medicine. The evidence showed that the plaintiff had been properly notified of the hearing before the Medical Committee on Grievances and that the same formal procedure required to hear and determine charges of unfitness against a physician was applied to the plaintiff. The supreme court held that, since the Regents were authorized to grant the plaintiff a license, they were likewise authorized, in their supervisory capacity, to revoke that license for proper and sufficient cause. The order revoking the plaintiff's license to practice physiotherapy was accordingly confirmed.—*Swift v. Graves, Commissioner of Education, et al., 19 N. Y. S. (2d) 686 (New York, 1940). — Reprinted with permission J. A. M. A.* **118**:*250 (Jan. 17) 1942.*

Annual Meeting of Foundation for Infantile Paralysis

The second annual medical session of the National Foundation for Infantile Paralysis was held at the New York Academy of Medicine, New York, December 3-5, with President Basil O'Connor, LL.B., presiding. A meeting of all medical advisers of the foundation, which opened the ses-

sion, was followed by a program covering the activities of the committees of the foundation.

Dr. Felix J. Underwood, Jackson, Miss., Assistance Rendered by the National Foundation to States During Epidemic Periods.

Dr. Edward A. Piszczek, Chicago, Study of an Outbreak in West Suburban Cook County.

Jessie L. Stevenson, R.N., consultant in orthopedic nursing, National Organization for Public Health Nursing, New York, Nursing Responsibilities in Epidemics of Infantile Paralysis.

Miss Lilyan Starr, executive secretary, Georgia state chapter, Atlanta, Functions of a State Chapter of the National Foundation During Epidemic and Endemic Poliomyelitis.

Charitable Hospitals: Liability for Burns Caused by Negligence of Nurse Employee

The plaintiff entered the Good Samaritan Hospital, a charitable corporation, as a pay patient to undergo a gallbladder operation. Following the operation and while still under the influence of the anesthetic, he suffered third degree burns on each of his legs. Subsequently he sued the hospital, alleging that the burns resulted from the negligence of a nurse employee of the hospital. From a judgment of the trial court sustaining a demurrer interposed by the hospital, the plaintiff appealed to the Supreme Court of Florida.

The hospital contended that the action of the trial court was proper since a charitable hospital is not liable for injuries caused by the negligent acts of one of its nurse employees, even though it charges those patients who are able to pay and even though the person injured is a pay patient. The hospital argued that the principle of nonliability of a charitable hospital under such circumstances is based on one or more of several theories. First, it argued, nonliability is accorded by reason of the so-called trust fund theory, that is, the funds of a charitable institution are held in trust for specific charitable purposes and should not be diverted to pay damages for negligence. The Supreme Court refused to accept that theory as an adequate basis for nonliability because the courts that have used that theory as a basis of nonliability have applied it so inconsistently. In most of the jurisdictions adopting that theory a charitable hospital has been held liable for negligent injuries to strangers and to employees and even to patients when the institution has been negligent in selecting its employees. If the "trust fund" theory is to be applied logically, said the Court, a charity should be exempt in all cases or not at all. The hospital next advanced as a reason for nonliability the so-called public policy theory—that is, it is contrary to public policy to permit an institution inspired and supported by benevolence and devoting its assets and energies to the relief of the sick and the needy to be held liable for the payment of a claim for damages resulting from the negligence of one of its servants. Public policy, answered the Supreme Court, should be determined by the constitution, laws and judicial decisions of a state. The constitution and laws of Florida, however, have gone no further than to exempt charitable institutions from taxation—not from liability for negligence. The hospital next urged that the doctrine of respondeat suuperior (that is, the master is responsible for the negligence of his servant while engaged in the master's business) should not apply to a charitable hospital because such a hospital receives no profit or benefit from the act of its servants. Here again, said the Court, if the doctrine of respondeat superior does not apply, then there should be no liability for injuries to strangers but liability under such circumstances is imposed by the courts on charitable hospitals. Whether or not the employees were servants so as to hold their employer liable for their acts of negligence depends on the nature of their duties, not the nature of the hospital.

Finally, the hospital contended that one who accepts benefits by becoming a patient of a charitable institution impliedly assents to hold it exempt from liability on any claim based on the negligence of its servants, that is, by accepting the benefit of the services of the institution, the patient assumes the risk of negligence. The Supreme Court held, however, that when a patient has paid a fair compensation for services rendered he cannot be said to have agreed impliedly to forego all claims for damages due to the negligence of the servants of the institution.

In conclusion, the Supreme Court held that it could not find any sound principle of law for exempting a charitable hospital from liability for the acts of negligence of its servants. The judgment for the hospital was accordingly reversed.—*Nicholson v. Good Samaritan Hospital 199 So. 344 (Fla., 1940). — Reprinted with permission from J. A. M. A.* **117**:*2003 (Dec. 6) 1941.*

War Budget for Polio Fight Must Be Substantial and Elastic

The war budget for the fight on infantile paralysis, to come for the current year from the proceeds of the Celebration of the President's Birthday on January 30, must be substantial and elastic. This is brought out in the third annual report of the National Foundation for Infantile Paralysis, issued to the public by the Foundation's president, Basil O'Connor.

"No one can say with any degree of accuracy how much money the National Foundation should have to find the answer to present problems and how much it may require to meet those yet to arise," he declares, indicating that no budgetary limit can be set.

"That it will need to have substantial sums in reserve to meet new developments and emergencies is clear to all those close to its activities.

"The procedure which the National Foundation has been following thus far has been designed to bring out in clearer relief the real problems and the best methods to be used for their possible solution," Mr. O'Connor said. "As that picture becomes clearer, the National Founda-

tion's activities will necessarily increase and expand.

"To discover, coordinate and disseminate knowledge of the cause of infantile paralysis, how it may be prevented and how its after-effects may be ameliorated, is at best a most difficult undertaking. It is, however, the job the National Foundation has set itself to do, and recent developments in the after-effects field, especially, have been most encouraging."

During 1941 the National Foundation spent $807,131.50 for research on the virus that causes infantile paralysis; for investigations of the possible relation of nutrition to the disease; for studies on after-effects of the disease and their treatment including the work of Miss Elizabeth (Sister) Kenny; for respirators, splints, frames, nursing and medical help and epidemic aid to communities, organizations and institutions during emergencies; and for educations of professional and lay persons.

An additional $23,885 was spent for the organization of more than 1,000 new local chapters composed entirely of volunteers. Today 2,500 counties in the United States are served by such chapters. For their work of aiding needy infantile paralysis victims, $1,137,222 was left with the chapters in 1941. — *Science News Letter.*

"Charge of The Light Brigade" Stops Measles, Fund Reports

The "Charge of the Light Brigade" that stopped measles in 22 primary and intermediate classrooms in Philadelphia and its suburbs, while the biggest epidemic on record raged in the rest of the schoolrooms of the city, is described in the annual report of the Commonwealth Fund.

The charge of this light brigade was directed by Dr. W. F. Wells and his wife, M. W. Wells, whose studies at the University of Pennsylvania the Fund has been helping to support since 1937.

The light brigade was made up of photons, particles of light. They made their charge from ultraviolet ray tubes hanging in aluminum bowls above the children's heads. Moving forward at a wavelength of 2,537 Angstrom units, which is a little shorter than that of the domesticated sunlamp, they met and destroyed whatever measles germs were lurking in the classroom air.

When measles began to pile up in Philadelphia in October, 1940, the report states, the children were ripe for it. During three years when there had been very little measles, the number who had never had it and were therefore susceptible to it had mounted enormously. More than one-fourth of the children in the primary grades of the Germantown Friends School were susceptible.

But the light brigade charged all day and every day in these primary classrooms. By May, when the epidemic had run its course, "nearly 60 per cent of these younger children, who should have fanned the flame of the epidemic, were still untouched."

Among 141 of the susceptible children in the high school and intermediate grades, unprotected by the light brigade, 88 had caught measles. Among 110 susceptible children in the primary grades, only 24 caught the disease, eight of these picking it up from someone at home, leaving only 16 who might have caught it at school.

In the Swarthmore public schools, where the light brigade also charged in the primary classrooms, practically the same results were obtained.

Even more important than stopping a measles epidemic and saving children from the dangers of this disease which are particularly great at younger ages, is the proof of a theory furnished by the charge of the light brigade.

According to this theory, measles and many other diseases, such as mumps and chickenpox, which explode suddenly into violent epidemics, are spread through the air. The germs of these diseases, it has long been believed, travel in the air on invisible droplets coughed, sneezed and quietly breathed into the air from human throats and noses. Reasonable as this theory seemed, evidence to support it was lacking for so long that many scientists discounted the importance of air in the spread of the disease.

The successful charge of the light brigade against measles seems now to show that "infection through the air is not only theoretically possible but quantitatively important."

The full worth of the light brigade in the war against disease will not be known until further painstaking studies have been made.

The war against disease of body and mind has been continued on many other fronts with the support of the Commonwealth Fund. Rheumatism and rheumatic fever, kidney disease and tuberculosis are among the diseases being attacked on the laboratory front, while in the field Fund-supported workers widen the application of present knowledge for fighting disease.

From England comes reports that child guidance clinics and related services, launched during peace time with help from the Fund and manned by many Fund-trained workers, have "literally proved themselves under fire" as the war put new burdens on British children and strained community resources for their care. — *Science News Letter.*

Dr. W. Kempton Browning-1874-1941

The central office of the Congress has just learned of the death of Dr. W. Kempton Browning at Camden, New Jersey.

Dr. Browning who practiced medicine in Camden and Merchantville for the past 45 years, was the only son of the late Congressman William J. Browning. Dr. Browning, an active member of the American Congress of Physical Therapy, was Vice-President of the Penna. Academy of Physical Medicine. The staff of the ARCHIVES and the members of the Congress express their condolence to the family.

BOOK REVIEWS

ARTHRITIS IN MODERN PRACTICE. THE DIAGNOSIS AND MANAGEMENT OF RHEUMATIC AND ALLIED CONDITIONS. By *Otto Steinbrocker*, B.S., M.D., Assistant Attending Physician and Chief, Arthritis Clinic, Bellevue Hospital, Fourth Medical Division, New York City. WITH CHAPTERS ON PAINFUL FEET, POSTURE AND EXERCISES, SPLINTS AND SUPPORTS, MANIPULATIVE TREATMENT AND OPERATIONS AND SURGICAL PROCEDURES. By *John G. Kuhns*, A.B., M.D., F.A.C.S., Chief of Orthopedic and Surgical Service, Robert Breck Brigham Hospital, etc. Cloth. Pp. 606 with 319 illustrations. Price, $8.50. Philadelphia and London: W. B. Saunders Company, 1941.

The increasing number of books on the various aspects of arthritis not only denotes the growing interest of the profession but suggests the need for more critical evaluation of the permanency of the newer contributions as a guide to the control of this many sided and complex disease. Within this formal group of recent publications none has stimulated more enthusiasm for the unity of therapy in the management of the rheumatic problem than has the author and his associate; yet despite the authenticity and integrity of the main body of this work there exists an obvious unbalance in exposition if not in appreciation of the utilitarian role played by physical measures in this the most involved of medical disorders. Looked at from the internist's angle the book is a splendid example of meticulous labor and detailed source of information on the latest methods in the diagnosis and classic medical treatment of arthritis and its complications. From the viewpoint of the clinician and specialist of this problem one could warmly acclaim this effort as an authoritative and scholarly review of the essentials in therapy and diagnosis, and render tribute to a work that includes an exhaustive and excellent summary of the most recent opinions on the subject. Indeed, in certain respects the work runs to such gratifying heights of authenticity and integrity—the final test of any book—that it places the reviewer on the defensive, were it not that the author, himself in one of the most cogent of prefaces touches with a certain amount of reluctance and temerity on principles of treatment which must be left to good judgment and "remain the unwritten ingredient in any prescription and in the application of any form of treatment." In this sense and in appreciation that the author's orientation with the delicate balance in physical therapy is of necessity the "unwritten ingredient" in his prescription, the scattered discussions on the exact role of physical procedures have been presented in such general and often vague fashion that it most often leaves the average reader with a sense of irritation and confusion. The author is to be commended for his courage and vision in extolling the benefits of colonic therapy because its definite clinical benefits in certain related conditions have been established beyond peradventure. And in line of constructive criticism it is respectfully suggested that the author might well introduce a special section in his next edition, revised and enlarged by one whose authority in physical medicine will permit him to correlate the important features of this discipline for the greater benefit of patient and lasting influence of this excellent contribution.

BIOLOGICAL SYMPOSIA: Volume III, MUSCLE. Edited by *Wallace O. Fenn*, Professor of Physiology, School of Medicine and Dentistry, University of Rochester, Rochester, N. Y. Cloth. Price, $3.50. Pp. 370. Lancaster, Pa. The Jaques Cattell Press, 1941.

This excellent book is one of a series of Biological Symposia devoted to the field of biology. The volume is edited by Dr. Fenn, Professor of Physiology at the University of Rochester, who has made many notable contributions to the subject of muscle physiology and who believes that muscle function can be studied frequently far more effectively on the living human subject than on laboratory specimens.

Each chapter gives a complete review of the latest contribution of the particular phase of muscle physiology under consideration and is written by men preeminent in their particular field. The subjects considered are muscle function as studied in single muscle fibers; muscle and the heart's motto; muscle excitability; action potentials and conduction of excitation in muscle; conduction in smooth muscles; the local activity around the skeletal neuro-muscular junctions produced by nerve impulses; action potentials of skeletal muscle; the regulation of energy exchange in contracting muscle; the action of muscles in the body; changes during muscle contraction as related to the crystalline pattern; the significance of oxidations for muscular contraction; on the nature of certain diseases of the voluntary muscles; the efferent innervation of muscle; theories of electrolyte equilibrium in muscle; and electric potential changes accompanying neuromuscular transmission.

Inasmuch as the physical therapeutist is largely concerned with the treatment of muscles, this volume should prove indispensable. The chapter on "The Action of Muscles in the Body," and the one "On the Nature of Certain Diseases of the Voluntary Muscles," are especially valuable to the physical therapeutist. This volume is an up to the minute review of information available on the subject of muscle physiology and will not be available in the average textbook of physiology for some considerable time. The format of the book is excellent; the subject matter is clearly presented and well illustrated. For those engaged in the practice of physi-

cal therapy research, this volume is highly recommended.

BODY MECHANICS IN HEALTH AND DISEASE. By *J. E. Goldthwait; L. T. Brown; L. T. Swaim,* and *J. G. Kuhns.* Third Edition. Cloth. Pages, 316, with 121 Illustrations. Price, $5.00. Philadelphia: J. B. Lippincott Co., 1941.

In summarizing the preface to their first book, the authors stated: "It seems to us that in a better understanding of the special structure and the special physiology of the individual, and in a broader knowledge of the changing physiology that should be part of the varying mechanics of the body, the solution of the problem of chronic disease is largely to be found." In the preface to the third edition, however, the authors have changed their attitude somewhat. They stated that the "fundamental principles described in the study of patients suffering from chronic diseases have become increasingly important. It has been found that they apply not only to the problems of disease, but even more to the study of the healthy, or near-healthy individual." In the third edition more emphasis has been placed on the maintenance of physical fitness and health, and more emphasis has been given to selection of many deformities which have had faulty bodily mechanics as the underlying cause of disease. A chapter has been added which deals with developmental deformities. A number of the chapters of the book have been entirely rewritten in order to include increasing knowledge of the application of the principles of correct bodily alignment to systems of the body or to certain diseases heretofore not considered related to the field.

The book has fourteen chapters. The first is short and deals with the problem of chronic medicine. The second chapter considers briefly the various bodily types and includes a distinction in the various types from the standpoint of posture, physiologic processes, susceptibility to disease and anatomic and functional features. General bodily mechanics in regard to the bones, spinal column, thorax, diaphragm and abdominal viscera are considered briefly in one chapter. Under the heading of developmental deformities, various deformities of the head, thorax, spinal column and extremities and their causative factors and effects are discussed. The circulatory system is considered in regard to bodily mechanics; a chapter on angina pectoris and posture emphysema as related to obesity and poor bodily alignment is included. Diseases of the abdominal viscera are discussed and each large abdominal organ is considered separately. Illustrative cases of visceral disturbances are presented in another chapter. Diseases of the central nervous system and chronic arthritis in relation to bodily mechanics are discussed. There is a good chapter on the foot, including a general consideration of shoes and exercises. There is also a chapter on the aspects of bodily mechanics in relation to public health.

The book is interestingly written and contains a large amount of excellent material with which every physician should be acquainted. Reasonably good physiologic explanations are given as to why certain conditions and diseases may be caused by poor bodily mechanics. A large number of cases are presented which illustrate how correction of bodily mechanics has aided in the treatment of various diseases.

The book might be criticized because the authors have attempted to cover so much material. For instance, the subject of scoliosis is given only one paragraph. Many important subjects are discussed, perhaps too briefly. Many case reports are given, some of which date back to 1912 and the latest of which is dated about 1932. Statistical studies are not given on any disease with the exception of an occasional statement such as "a large number of cases"; a series of 300 patients is mentioned casually, but the figures are not broken down. Such statements that many cases of arthritis are "the result of chemical poisons from disturbed intestinal digestion or faulty metabolism, which give a similar appearance clinically to the changes brought about by bacterial products, but which respond only to revised diet, intestinal care, and correction of metabolic errors," have not been substantiated.

Concerning bodily mechanics in multiple sclerosis, the following statement is made: "If this correction can be accomplished in the early stages of the disease its progression can be retarded and in a number of cases improvement will result. Primary lateral sclerosis which shows a somewhat similar pathologic picture, confined usually to the pyramidal tracts of the cord, has a similar relation to body mechanics in its cause and treatment." This statement seems to need more corroboration than a single report of a case. The authors further stated that by changing the bodily mechanics in cases of paralysis agitans, not "only have these deforming features been lessened, but a gradual improvement in the distressing symptoms has also been observed." The authors did not say how many cases they had. Two reports of cases of diabetes mellitus are presented. One of the patients was an elderly woman who had gangrene of the foot. The authors stated: "The case was handled from the point of view of correction of faulty bodily mechanics and the results were as expected, except that the changes were more rapid."

The enthusiastic and definite statements made concerning the diseases just mentioned in regard to results obtained through correction of bodily malalignment alone may lead to misjudgment and condemnation of the book. Isolated reports of cases, some of them reported from ten to thirty years ago, do not carry much weight when there is little or no other experience cited except in a vague manner.

INFANTILE PARALYSIS. A SYMPOSIUM AT VANDERBILT UNIVERSITY, April, 1941. By *Paul F. Clark,* Ph. D., Professor of Bacteriology, The University of Wisconsin Medical School; *Charles Armstrong,* M.D., Senior Surgeon, United States Public Health Service; *Thomas M. Rivers,* M.D., Director, The Hospital of the Rockefeller Institute for Medical Research; *Ernest W. Goodpasture,* M. D., Professor of Pathology, Vanderbilt University School of Medicine; *John R. Paul,* M.D., Professor of Preventative Medicine, Yale University School of Medicine; *Frank R. Ober,* M.D., John B. and Buckminster Brown, Clinical Professor of Orthopedic

Surgery, Harvard University Medical School. Cloth. Pp. 239 with 37 Photographs and Photomicrographs and 8 Other Figures. Price, $1.25. New York City: The National Foundation for Infantile Paralysis, Inc., 1941. Composed and printed at the Waverly Press, Inc., Baltimore, Maryland.

This is a series of six excellent lectures by recognized authorities covering the whole subject of poliomyelitis. Clark has traced the history of the disease from Badham and Heine through Wickman and Landsteiner and Popper to the present. Armstrong has reviewed the development of our present knowledge of the virus, its geographic distribution, its location in human tissues, its infectivity for animals, and some of its cultural characteristics. After an excellent discussion of the immunology and serology of poliomyelitis, Rivers has voiced his disappointment that as yet we have no effective prevention or treatment based on our knowledge of immunity. In the discussion of pathology by Goodpasture, the chronologic development is connected with such well known names as Charcot, Rissler, Flexner, Lewis, and Hurst. Paul's lecture on epidemiology begins with the recognition of poliomyelitis as an epidemic disease in Scandinavia in 1880 and discusses its development to the present time as influenced by such factors as geography, season, rainfall, age, and distribution of population, carriers, and avenues of infection. The greater gart of the chapter on treatment and rehabilitation by Ober is devoted to brief descriptions of the various surgical procedures for the correction of deformities during the chronic stage of the disease. Some might desire more detail concerning treatment during the acute and convalescent stages. The Kenny treatment is not mentioned. This volume is recommended to those who desire an authoritative and concise yet comprehensive discussion of all phases of poliomyelitis.

NASAL SINUSES. AN ANATOMIC AND CLINICAL CONSIDERATION. By *O. E. Van Alyea,* M.D., Assistant Professor, Department of Laryngology, Rhinology, and Otology, University of Illinois College of Medicine, Chicago. Cloth. Price, $6.50. Pp. 262. Baltimore: The Williams & Wilkins Company, 1942.

For a number of years the author of this work has conducted intensive anatomic studies on the nasal sinuses. At the same time he carried on a considerable amount of clinical investigation. The two have given him an unusual opportunity to organize this present work, which, however, does not purport to cover all phases of sinus disease. Very little space is given over to malignancies or to unusual conditions or rare diseases. "Rather that space has been taken up with subjects most likely to interest rhinologists as a whole." The chapter subjects follow in logical sequence commencing with histopathology and ending with general surgical and non-surgical therapeutic measures. It is obvious from even a superficial perusal of the book that the author is well balanced in his views not only as pertains to diagnosis but more especially treatment. Wherever technic is described it is done so that the steps can be easily followed. The anatomic descriptions are well done. The illustrations show painstaking preparation. In all the material is well prepared, well arranged, authentic, and up to date. It is difficult to understand how any progressive rhinologist can fail to have this work within easy accessibility. It is a genuine pleasure for the reviewer to commend the author for this scholarly effort.

ESSENTIALS OF GENERAL SURGERY. By *Wallace P. Ritchie,* M.D., Clinical Assistant Professor, Department of Surgery, University of Minnesota Medical School. Cloth. Pp. 813. Price, $8.50. St. Louis: The C. V. Mosby Company, 1941.

This book is intended for the undergraduate student of surgery. Despite the enormity of the subject the author has succeeded admirably in presenting the essentials in a single volume. Since operative surgery is not within the realm of the undergraduate student, considerable of this phase has been excluded. It should not be assumed that this volume affords a short cut to a knowledge of surgery or of surgical principles. "It is presented, however, with the hope that it will give the beginning student some basic outline of the important points which he must master and the advanced student a review by means of which he will be able to recall the more extensive works with which he should have had contact." Some of the chapters are written by members of the staff of the University of Minnesota Medical School. While no claim is made of originality, the method of approach is sufficiently different from most of the other surgical texts to merit commendation. The material is arranged in logical sequence and the fundamentals are adequately described and discussed to be easily understandable. The contributed chapters follow the general scheme of the author. The 237 illustrations should prove helpful to the modern medical student who is desirous of covering the subject of surgery as it should be studied. The references at the close of each chapter suggest additional sources for reading. In general it may be said that this book is representative of modern trends in teaching undergraduates. It is a scholarly presentation of a difficult subject. The author is to be congratulated for completing what must have been a gigantic task. It has, however, been well done.

MEDICAL PROGRESS ANNUAL, 1940. A SERIES OF FIFTY-TWO REPORTS PUBLISHED DURING 1940 IN THE NEW ENGLAND JOURNAL OF MEDICINE. By *Robert N. Nye,* M.D., Managing Editor. 625 pages. Price $4.00. Baltimore and Springfield, Charles C. Thomas, 1941.

This is the second of the series of articles reprinted in book form from a current year's issues of the *New England Journal of Medicine.* These series represent a noteworthy effort to bring to the close attention of all physicians advances and improvements in medical practice that in the opinion of the authors have been accepted and should be utilized. There are fifty-three articles in this vol-

ume, alphabetically grouped from abdominal surgery to wartime preventive medicine, practically all written by members of the teaching staff of Harvard Medical School and Massachusetts General Hospital. Physical therapy is not represented among the subjects, but since a recent issue of the Journal contained an article on progress in physical therapy, next year's volume should make up for the omission in the present one. There are ample references with each article and there appears a uniform tendency to present the large variety of subjects in an easily readable, concise and practical style. As a one-volume authoritative summary of a year's progress in clinical medicine, this work fills a desirable role for general physicians, specialists and advanced medical students.

AMERICA'S NUTRITION PRIMER. By *Eleanora Sense*. Introduction by Doctor *E. V. McCollum*. First edition. Cloth. Ten pen sketches. Pp. 86. Price, $1.00. New York: M. Barrows and Company, 1941.

This is an excellent little book of ten short chapters presenting, in simple language and entertaining popular style, scientific facts in regard to nutrition. The first five chapters are devoted to a discussion of food elements and their relation to human nutrition. This section contains discussion on proteins, vitamins, minerals, and fuel foods. The remaining chapters are given over to food purchasing, food preparation, budget-saving menus, and recipes. From a scientific standpoint the book is authentic and up-to-date. There is no attempt at therapeutic dietetics. Physicians need not hesitate to recommend this work to their patients as a guide to a balanced ration.

CURRENT BIOGRAPHY. WHO'S NEWS AND WHY, 1940. Edited by *Marine Block*. Cloth. Pp. 928 with 650 illustrations. Price on application. New York: The H. W. Wilson Company, 1940.

For those who prefer their information on contemporary personalities to be brief and authentic, "Current Biography" provides a concentrated and intelligent source about today's and tomorrow's "headliners" under the mixed virtue of brevity, color and authority. This volume is to the researcher what the public bakery is to the modern home—convenient, labor saving and in good taste. The 1940 edition presents the life story of over 1,000 famous national and international leaders in all professions, and is compiled with that factual detail as to include a generous reference background for the edification of the more inquiring readers. Leafing these voluminous, illustrated pages one encounters more interesting tidbits of information than is to be found in volumes whose multiplication runs well into plural figures. The material represents the roll-call of a living cavalcade of famous men and women whose labors have richly contributed to the weal of our contemporary world. At random one's attention becomes fixed on the current biographies of such living distinguished persons as Drs. Morris Fishbein and Thomas Parran, on the lives of Alexis Carrell and Maude Slye, and no less on the necrologies of such recently departed figures as Hans Zinsser, Schereschewsky and many others who had labored with equal success and zeal in the same classic sphere. Briefly, this volume includes living histories and obituaries of the leaders of some twenty-five classified professions, such as, among others, the arts, diplomacy, education, finance, government, industry, journalism, literature, law, medicine, science, sports and the theatre. For concise and authoritative information on the personalities that are making history for future generations this volume has provided an important source of information to readers and libraries interested in current events, and to patrons who like to know "Who's News and Why."

BEITRAGE ZUR RONTGENDIAGNOSTIK DER OTITIS MEDIA ACUTA UND IHRER KOMPLIKATIONEN IM SCHLAFENBEIN. By *Solve Welin*. Supplement 42. Paper. Pp. 180. Price, (resp.) 15 and 20 Sw. Cr. Stockholm: Acta Radiologica, 1941.

This monograph represents an important contribution in a somewhat neglected field. It is a comprehensive treatise bringing up to date present day knowledge of the application of diagnostic roentgenology to otology. An excellent discussion of roentgen technic, and roentgen and developmental anatomy of the temporal bone is presented. There follows a complete description of mastoiditis and its complications, including petrositis. The literature is thoroughly reviewed and the author's extensive personal experience is well reported. The work is profusely illustrated with reproductions of better than average detail. This monograph should prove a valuable addition to the library of every otologist and roentgenologist and is well worth reading in its entirety.

THE MARCH OF MEDICINE. New York Academy of Medicine Lectures to the Laity, 1941. Price, $2.00. New York: Columbia University Press, 1941.

This is the third of the volumes of the published "Lectures to the Laity" by outstanding authorities under the auspices of the New York Academy of Medicine. The purpose of these lectures is to show historically how medicine has developed and to reveal its social and cultural significance. The lectures of this series consist of: "Humanism and Science," by Alan Gregg, M.D.; "Paracelsus in the Light of Four Hundred Years," by Henry E. Sigerist, M.D.; "Psychiatry and the Normal Life," by William Healy, M.D.; "Philosophy as Therapy," by Irwin Edman, Ph.D.; "The Promise of Endocrinology," by Oscar Riddle, Ph.D.; "What We Do Know About Cancer," by Francis Carter Wood, M.D. The lectures are written so that they presuppose neither special knowledge of medicine nor familiarity with scientific vocabularies. They portray fascinatingly the human interest in relation to disease and are free from the tedium of systematic monographs. Each of them can be read with profit by physicians as well as by laymen. The New York Academy of Medicine has indeed rendered a significant service to the public in fostering these lectures.

PHYSICAL THERAPY ABSTRACTS

The Rehabilitation of the Industrial Worker.* H. Worley Kendell.

In our present crisis it is needless to emphasize the importance of the industrial worker and the part that he is playing in the vast defense program. Since this war has been described as a war of machines rather than of men, industry plays the major role both at home and abroad. It can be assumed that the industrial worker who is such an important cog in the wheel of fortune will play an equally important role in the years which come after the present crisis is terminated and any help this group of people can be given will be more than repaid in the future.

Since hospital insurance is available to the majority of industrial workers who are disabled because of illness or injury, many of the patients who were treated in the home now present themselves at the hospital, where a complete study can be made and a coordinated program can be outlined. In addition to the usual medical and surgical treatments, physical medicine can be of great value in hastening the rehabilitation of the worker and an adequate nutritional program, worked out while the patient is in the hospital, will be of benefit to him not only at that time but also when he returns to his home and his job.

In the treatment of industrial injuries the chief goal to be attained is the restoration of function to the injured part as quickly and as completely as possible. It is here that physical medicine can play an important part. Among the physical agents which can be used with benefit in the treatment of industrial injuries are heat, light, water, electricity, massage, exercise and occupational therapy. The employment of these in their simplest form, under close supervision and frequently at the patient's home, is highly to be desired. An important contribution of physical therapy is the reeducating of the badly maimed worker to do a new type of remunerative occupation which will make a useful worker of a potential invalid.

Rehabilitation of the industrial worker is hastened by a well-balanced nutritional program. The majority of the industrial patients who are hospitalized as the result of injury are able to maintain normal gastrointestinal function and, therefore, the dietary problem will be somewhat different from the patient suffering from a particular disease entity, as their diet will be similar to that when they are on the job. A diet may be suggested which can be incorporated into his home program, thereby benefiting not only the patient but his family as well. Nutrition plays a very important part in our present program, as the adequately fed worker is much more satisfied and competent in doing his work.

* Read before the Ohio Dietetic Association, November 14, 1941.

Management of Peripheral Vascular Disease. Geza de Takats.

Illinois M. J. **80**:307 (Oct.) 1941.

In discussing the use of physical therapy in peripheral vascular disease the author first mentions heat.

Heat in all forms is useful, but the cheapest, safest, and most effective is the continuous or intermittent use of a "baker." If the patient is bedridden, heat should be applied continuously. If the patient is ambulatory, it is easy to utilize the night for a prolonged use of the baker. If the patient is complaining of pain under the heat cradle, it signifies that he is getting too much heat. In case of heat-intolerance, it is best to apply heat to the root of the limb. Generally speaking, it is safest to wrap the affected limb in cotton and move the cradle up toward the root of the limb.

Alternate hot and cold baths are frequently used to "tone up the blood vessels." In the experience of our group their value is rather questionable in peripheral vascular disorders. They tire the patient, macerate his skin, cannot be used in the presence of gangrene, and may even aggravate vasoconstriction.

Postural exercises have a sound foundation, and oscillometric curves illustrate the increasing pulse volume in the dependent position. They may be done actively by the patient or passively by an oscillating bed.

Massage is a time-honored method to improve circulation. In the absence of venous or recent arterial thromboses and when the skin is intact, mild massage may overcome vascular spasms and produce a reactive hyperemia. We have more efficient methods to produce reactive hyperemia.

To heat up the lower extremity, electrodes are placed on the abdomen and the lower back. For the treatment of the upper extremity, the electrodes are placed on the side of neck and the upper dorsal spine. We have not placed electrodes on affected limbs, as they are increasingly sensitive to burns.

Vasodilators such as histamine, acetylcholin, and mecholyl have been introduced through the intact skin by placing them on the positive pole and carrying them into the tissues by the galvanic current. We found in unpublished observations that the skin often developed a refractory state, with increased pigmentation and thickening and that the liberation of vasodilator substances from the patients own tissues was a far simpler and more economical method. The use of sodium chloride, however, by iontophoresis has

given encouraging results in scleroderma and thrombophlebitic indurations.

Passive Suction and Pressure Exercise. A physical method of dilating collateral arterial pathways of an extremity, whose major arterial pathways had been occluded by trauma or disease, has been called passive vascular exercise. The effect of machines that produce alternate suction and pressure in a transparent boot surrounding the extremity, is variable.

In analyzing the mechanism by which alternating suction and pressure exert their effects on peripheral circulation, Hick, Coulter and the author were struck by the fact, that with each period of suction, there occurs constriction of the thigh at the cuff, which is released during the positive phase. While any blood pressure apparatus can be used to produce intermittent venous stasis, a wide, eight-inch cuff, conically shaped to fit the thigh is preferable. The amount of pressure should not exceed the diastolic pressure of the extremity at that level.

Gonorrhea in the Female. E. N. East, and S. A. McFetridge.

Canad. M. A. J. **45**:250 (Sept.) 1941.

This is a report of 1,712 women who presented themselves for examination at the Vancouver Clinic, Division of Venereal Disease Control, Provincial Board of Health, British Columbia. Of these, 626 were proved to have gonorrhea.

A routine physical examination was done on all patients. Routine tests consisted of a three-day examination. On the first day smears were taken and were examined by means of Gram's stain. If no evidence of gonorrhea was found, the urethra was painted with 2 per cent silver nitrate and the cervix with 5 per cent silver nitrate. On the second day smears were taken again and the silver nitrate repeated. On the third day smears and cultures were taken.

Trichomonas vaginalis infection was present in 20 per cent of the patients.

Gonorrheal infection of the rectum was present in 8 patients, but only those patients complaining of rectal symptoms were examined. Cases were classified as acute, subacute and chronic. In the acute stage local and surgical treatment are contraindicated; in the subacute stage surgical treatment is contraindicated; and in the chronic stage surgical treatment can be undertaken safely. All patients received sulfanilamide therapy. One course at least was given, and if the drug was well tolerated two courses were given. There were 64 per cent of cures on sulfanilamide therapy alone. Pelvic complications were present in 9.2 per cent of the patients.

Factors preventing complications were considered to be sulfanilamide because of its curative virtue and also because it discourages local treatment during the acute stage when local interference is contraindicated. Trauma, sexual contact, many pelvic examinations during the acute stage, etc., are contraindicated. Rest in bed with the menstrual period, especially the first, is important in the prevention of pelvic complications.

Joint Debridement. Paul B. Magnuson.

Surg., Gynec. & Obst. **73**:1 (July) 1941.

It has been assumed in general by the medical profession that a joint damaged as a result of any form of arthritis is beyond help, except by the eradication of any possible foci of infection which might be found or the elimination of chemical disturbances of metabolism.

The author has opened and inspected a total of 83 joints in 72 patients suffering from various forms of arthritis, and it is from the experience gained in this series that this report is made.

Thorough removal of all mechanical irritating products of joint degeneration will, in a large percentage of cases, render the patient symptom free. Even when the degenerative process has progressed to a point at which there is practically no healthy cartilage, the operative procedure described will result in remarkably good joint function. The denuded areas are covered with fibrocartilage which serves as a satisfactory substitute for hyaline cartilage in the advanced cases, and in the less advanced cases the progress of the disease is stopped, or at least long delayed, by the removal of mechanical irritants.

Removal of the synovia has not been found necessary and has been done only in some cases of atrophic arthritis which are not reported in this paper.

The selection of patients and the after-treatment are as important as the operation itself. If the patient is not willing to help, the operation had better be left undone.

In after-treatment motion is started on the fourth day. Muscle exercise is of prime importance. The patient should be required to use the muscles both in flexion and extension and it has been found helpful to synchronize the use of the muscles on both extremities, moving the unaffected limb at the same time that effort is made to move the affected one. This must be done regularly and consistently.

If it is a weight-bearing joint, the patient is put on his feet on the eighth to tenth day folfowing operation. Prior to this it should be possible for the patient to completely straighten the knee or hip. Too much importance cannot be attached to this point. No pain is caused if the weight falls in the right line, but if there is slight flexion of the joint the soft tissues surrounding the joint, which are painful and tender, will be strained, the patient will have acute pain and will not rest weight on the joint because of fear of pain, once it has occurred.

It has been the author's custom to assist the patient out of bed and while he is sitting on the edge of the bed, or leaning against it, get the joints in proper weight-bearing line. He then stands behind the patient, supporting the elbows and forearms on his arms and forearms. The patient is requested to hold his chest up, tail in, knees back and hips straight. It is easier to do

this standing behind the patient, supporting him strongly, than to stand in front of him or allow him to use crutches, under which circumstances he always has a tendency to bend forward. If the patient is straight, his joints are in proper weight-bearing line and he will not have pain.

The first day's lesson is in standing only. He is assisted into bed without causing pain.

It is a good plan before the patient begins the walking exercises to have assisted motion while in bed. In the case of the knee, the patient may sit on the side of the bed with the leg hanging over the side, the heel supported in the palm of the surgeon's hand, and be instructed carefully in muscle contraction and relaxation, so that he may see the knee move under his own power and see the muscles work. In the case of the hip, a sling is put under the knee and a rope attached to this sling is run up over a pulley on a frame and terminates in a handle which the patient can grasp and give himself assisted motion. It is important that the hip and knee come into full extension after each flexion, and they will not do this if they are simply allowed to come in contact with the mattress; the body sinks into the mattress at the hip level, consequently there is slight flexion of the hip and, as a result, slight flexion of the knee. Therefore it is necessary to turn the patient into a prone position several times a day and see that the affected weight-bearing joint comes into full extension.

Gentle rhythmic massage is given daily, as is also muscle training. Heat is helpful in any form chosen, and for a substantial part of every twenty-four hours. If these procedures are carefully followed, it is perfectly astonishing how soon the patient will have 90 degrees of motion and full power in the joint. Too much emphasis cannot be put on careful supervision of after-treatment.

Electrical Convulsion Therapy in Mental Disorders. Grant E. Metcalfe.

J. Indiana S. M. A. 34:455 (Sept.) 1941.

By treating patients in the general hospitals of the community, where electricity can be used as the convulsant, the problem of anxiety and terror which occurs between the injection of metrazol and the convulsion, and the consequent apprehension to further treatment, are eliminated, for the loss of consciousness is almost instantaneous. A great part of the brain is instantly stunned by the shock so that no pain impulse set up in the head reaches the thalamic centers in time to be consciously integrated. There is a retrograde amnesia for about two minute before the current is applied. Interrogation of treated patients, even a few minutes after they have regained consciousness, clearly demonstrates this amnesia. The nursing problem of psychomotor excitement following the metrazol convulsion is largely eliminated, for most of the patients wish to sleep. In no case where psychomotor excitement has been present has it ever reached the extent or lasted as long as has been observed in the metrazol postconvulsive state.

The number of individual treatments varies considerably, the average is from ten to fifteen, but many patients respond with less. It is usually possible (in the case with a favorable outcome) to note improvement after five or six treatments. Depressive types respond more rapidly than other types of psychoses. The only criterion followed is to continue treatment until remission or improvement takes place, or until it is felt that nothing is being accomplished. Ordinarily treatment is not discontinued until twenty-five have been given without improvement. Fox and von Braunmuhl feel that there is no reason why remissions cannot be prolonged indefinitely with maintenance shocks.

The Kenny Treatment of Infantile Paralysis. Wallace H. Cole, and Miland E. Knapp.

J. A. M. A. 116:2577 (June 7) 1941.

To date 26 patients with acute anterior poliomyelitis have been treated under observation by this method. Twenty received the Kenny treatment within two weeks after the onset of the disease. Eleven have already been discharged completely normal. The average hospital stay of these patients was thirty-six and two-tenths days. Of the remaining 9, 1 has paralysis of both legs which will probably be permanent. One was admitted only three weeks before the date of writing.

The other 7 are progressing satisfactorily, but it will take time to establish the extent of their final recovery.

In this series 11 of 20 patients are normal within two months after the onset. It is expected that at least 5 of the others will recover completely within a reasonably short period of time.

Of the 6 patients on whom the Kenny treatment was started from two weeks to two months after the onset of the disease, 2 have been discharged as completely well, 1 will probably have permanent paralysis of one arm and 2 are quite likely to have some degree of permanent paralysis. This would seem to indicate that early treatment may have some value in preventing the development of severe disabilities.

It is impossible at this time to attempt to evaluate end results or to do more than indicate impressions. Epidemics vary in their severity from year to year, and the percentage of the hospitalized patients who would have recovered completely under the usual therapy cannot be accurately estimated.

The patients observed were much more comfortable and cheerful during the acute stage than are those who are immobilized. Thus far, we have seen no contractures or deformities following this treatment. Even the most severely paralyzed patient has passively full range of motion in all his joints. Scoliosis or other spinal deformity has not developed in these cases. In most of them there is more flexibility than there was before the onset of the disease. The patients are more comfortable and more cheerful, and it appears that the disability is less severe than would have been expected ordinarily. Certainly harm has not resulted to any of the observed patients under Miss Kenny's care from "abandonment of immobilization."

Cancer of the Lower Lip. Treatment With Radiation. John H. Lamb, and William E. Eatland.

J. A. M. A. 117:600 (Aug. 23) 1941.

The various kinds of cancer of the lip all seem to originate in certain precancerous conditions such as leukoplakia, sun or "fever" blisters, senile keratoses, keratoses due to irritation from jagged or broken teeth and granulomas arising in razor cuts or from simple scratches.

Actinic lesions such as sun or "fever" blisters and actinic keratoses were by far the most numerous early precanceroses noticed by the authors. The patient's description of the earliest lesions is a blistering or sunburn in several areas on the vermilion border of the lower lip. Some had chronic actinic cheilitis of the entire exposed surface of the lip, with dryness, scaling and fissuring. With continued exposure to the sun a more persistent lesion is formed in one area. On examination this is seen to be an erosion, not a herpetic condition. There is usually some degree of superficial crusting; hence the term "fever" blister as used by the patients. These lesions heal but recur with exposure to the sun, after which two types of lesion seem to follow. The first is the formation over the blistered area of a keratotic scale which when peeled off yields a bleeding surface, (keratosis solaris). Later a superficial induration spreads under this keratoma and infiltrates into the substance of the lip until a button-shaped induration can be palpated beneath the epithelium. The second type of lesion is one that sometimes develops rather rapidly from the sun erosion. After several recurrences, according to the patients, the erosion fails to heal and progresses into a denuded, slightly elevated, crusted, indurated growth. As this proliferates the borders become slightly elevated and infiltrated. Secondary infection, which invariably takes place, may eventually cause the growth to become fungating. Metastasis sometimes has been noted when the lesion was less than 2 cm. in diameter. This type is also found among the younger, more active patients. A pathologic study is being made on such lesions, but no discussion can be made in this paper except to state that the pathologic processes of an early sun blister is similar to that produced by mechanical or chemical burns.

Conservative Treatment of Habitual Luxation of Shoulder. B. Heger.

Wien. med. Wchnschr. 91:21 (Jan. 11) 1941.

According to Heger, dislocation of the shoulder is a frequent sport injury. The relatively small glenoid cavity, a wide, loose capsule and trauma at the elbow or directly to the shoulder are among the factors responsible for the frequency of luxation of the shoulder joint. The complicated ligamentomuscular apparatus is stretched or even torn during dislocations, and the capsular tear offers an insurmountable obstacle to reposition. The dislocation together with belated reposition is often responsible for habitual luxation of the shoulder joint, which the author defines as repeated dislocation in case of direct or indirect exertion of slight force or in case of extensive movement. The author considers only the traumatic forms. The great number of therapeutic methods that have been suggested, indicate that the therapy of habitual luxation is difficult. Treatments by means of tapes and pressure pads are unsuccessful, because they limit the motility of the arm and produce atrophies. Prolonged immobilization is to be rejected, particularly that which forces fixation in a direction apparently opposite to that of the luxation, because it leads to ankylosis. Early movement has proved helpful. The method used by the author makes use of this factor. It attempts to produce shrinkage of the capsule by injecting around it the patient's own blood and attempts to strengthen the musculoligamentous apparatus by systematic exercises. The author thinks that failures following similar treatments were caused not so much by the methods as such but rather by their application, the choice of substances and the selection of cases. To select the cases roentgenoscopy is advisable, because all cases in which there are defects in the bony part of the joint are unsuitable for this treatment, as are also cases in which severe tears of muscles and ligaments have occurred. The injections are given once every week and consist of 6 cc. of the patient's own blood and 4 cc. of the cytozym of hogs' lungs. They are introduced at several points through the deltoid muscle to the articular capsule. The author thinks that the cytozym makes the joint firmer by causing local irritation. Every injection is followed by twenty-four hours of immobilization. Beginning after the second injection, resistance exercises in the form of abduction and adduction and of pressing the arm forward and backward are begun and are gradually increased. At the end of seven injections the entire capsule has usually been surrounded by injections. The author does not think that this method will do away entirely with the surgical treatments of habitual luxation of the shoulder joint but that in suitable cases, particularly in athletes, the described treatment should be tried first. — (Abstr. J. A. M. A. 117:970 [Sept. 13] 1941.)

Résumé of the Present-Day Treatment of Arthritis. Thomas K. Lewis.

J. Med. Soc. New Jersey 38:391 (Aug.) 1941.

Discussing atrophic arthritis, the author stated: Focal infection plays an important role in the progress and development of the disease in a large percentage of cases. Vaccines and bacterial antigens in some cases seem to give definite relief, but in many instances they accomplish nothing. Foreign protein reaction is discredited by many writers, and warmly supported by others. There is no evidence to support the use of bee venom and snake venom. No dietary measure is in itself curative. Intestinal therapy, chiefly in the form of high colonic douches, is advocated by many; but the consensus seems to be opposed

to its routine application. The use of vitamins B, C, and D has been suggested as a possible cure for arthritis. The results of their use have been disappointing in so far as the course of the disease is concerned. No drugs have been proved specific, and none have been proved curative. Simple analgesics, such as the salicylates, phenacetine and antipyrine, are of value. Fever therapy has been most disappointing. Climate seems to play an unimportant role. Sympathectomy has given no evidence of producing cures. Psychotherapy is of no value in curing arthritis. Orthopedic measures are frequently indicated; and while we do not hold with the orthopedist that rheumatoid arthritis is primarily an orthopedic problem in all cases, we do advocate the use of orthopedic advice at no infrequent intervals. Physical therapy undoubtedly has a place in the treatment of arthritis; but caution should be observed in its use. Diathermy gives relief and benefit in some cases. Massage for the improvement of muscular tone is of distinct value. Rest and exercise in proper proportion should be adjusted for each patient. It is not a matter of rest or exercise, but rather a matter of rest and exercise in the proper proportions for the individual case.

In the management of rheumatoid arthritis, the author pointed out that (*a*) accurate diagnosis was necessary; (*b*) the diagnosis of rheumatoid arthritis having been established, the physician should explain to the patient that the road ahead will be long and trying; (*c*) removal of established foci of infection; (*d*) trial of foreign protein reaction or vaccines or both in an effort to stem the progressiveness of the disease; (*e*) careful attention be given to nutrition; (*f*) detailed instructions given as to rest, exercise, forms of diversion, and the amount and kind of work; (*g*) there should be alertness as to the necessity or indication for orthopedic consultation; (*h*) the use of physical therapy according to indications, probably only after conference with the orthopedist.

Physiological Scoliosis. Aladar Farkas.

J. Bone & Joint Surg. **23**:607 (July) 1941.

Prior to its recognition by anatomists and other investigators, the existence of physiologic scoliosis had been constantly observed by tailors and dressmakers for many centuries, of course, without their having recognized the condition. As the physiologic scoliosis increased with advancing age, the tailor or dressmaker would become suddenly aware that the shoulders of the customer were no longer level and that one of the hips had become prominent. The whole stature of the person had changed, and it would become necessary to camouflage the usual physiologic deformity ascribed to age. The main reason for the change was nothing but physiologic scoliosis, which, by shifting of the shoulder girdle from one side of the hip line to the other, had finally changed the stature.

The existence of physiologic scoliosis was scientifically established over one hundred and fifty years ago by Sabatier, who found that the great majority of adult spines showed a well-defined curve to the side; in the lumbar and cervicothoracic segments the convexity was usually to the left side, and in the thoracic region, to the right side.

Measurement of the 12 thoracic and 5 lumbar vertebrae of 21 normal spines and of one scoliotic spine, ranging in age from six to eighty-six elicited the following conclusions:

1. The postnatal development of normal spines becomes asymmetric at about the age of six, progressing with advancing age.

2. The asymmetry concerns the vertebral body and pedicles as well as the arches. The most striking feature of the asymmetries found was the dorsoventral elongation of the vertebral bodies: in the upper thoracic region, on the left; in the lower thoracic segment, on the right; and in the lumbar region, on the left. Besides this, the lengthening of the pedicles on the side of the elongation and broadening of the pedicles on the other side, and the deviation of the arches opposite the side of the dorsoventral elongation could be regularly observed.

3. Since the spine in all of the specimens except that of the normal six-year-old showed marked lateral deviation, the asymmetric postnatal development of the spine represents physiologic scoliosis.

4. In physiologic scoliosis, contrary to the observations in pathologic scoliosis, the wedging of the vertebrae plays but a subordinate role. The curves throughout are composed of lozenge-shaped (rhombic) vertebrae, representing the prescoliotic stage of the deformation without marked signs of motion in the articular processes. Further differences between physiologic and true scoliosis are as follows: In physiologic scoliosis the physiologic sagittal curves never disappear, and, furthermore, in none of the specimens examined were all of the bone elements of the same vertebra concerned at the same time; in true scoliosis all of the parts of the vertebrae are more or less deformed.

5. The osteophyte production always starts at the ventral edge of the dorsoventral elongation.

6. In physiologic scoliosis, as well as in pathologic scoliosis, the deformation of the spine takes place in the diagonal plane, never in the exact frontal plane.

7. The cause of physiologic scoliosis is the human gait, which forces the spine into a threefold curve, alternately changing at every step. However, the innate normal asymmetries of the human body eventually establish permanent lateral curves of the spine, showing marked individual variations within the general law.

"Light Death" and Irradiation With Light. Julius V. Ries, and Marie V. Ried-Imchanitzy.

Radiol. Clin. **9**: Number 5, 1940.

This article of forty pages with illustrations discusses much past experimental data and reports some new experiments conducted at Naples dealing with the effect of light on some of the

"glass clear" animals in warm sea waters. Interesting discussions of the general subject of the significance or reason for the color of certain natural pigments in the interior of the bodies of large animals are followed by reports of simple artificial systems that purport in part to duplicate the functions of the naturally occurring pigments in large animals. For instance a suspension of chalk in water in a transparent container surrounded by a transparent container holding a solution of a yellow-green dye which in turn was surrounded by a transparent container holding a red dye solution was devised to simulate the conditions of a white or colorless organ of the body surrounded by yellow-green bile pigment and this in turn protected by a red blood pigment. Such systems when exposed to sunshine and other radiation show little or no temperature rise in the white portions. This is correlated with the absorption spectrum of the protecting solutions which are shown to absorb the majority of the radiation. Further experiments with colored flowers in the presence of different forms of radiation show a relation between the color which is dependent on the absorption spectra of the pigment and the kind and amount of radiation from various natural and artificial light sources that can be withstood without injury to the living cells of the flower. The experiments with the "glass-clear" marine animals (jelly fish) involved studies of the Cetenofores and Meduses that were available at Naples. Normally these beings are not affected by the light because their transparent crystal-clear bodies pass the rays without restraint. When artificially dyed with a blue-green color they absorb the red and heat rays usually without injury since the temperature does not rise because of the surrounding cool water which absorbs the increased energy absorbed. When dyed with red dyes, however, the animal absorbs the short wave radiations which result in the rapid injury or "light death" of the animal. The phosphorescence of these animals also was studied with these conclusions:

1. The phosphorescence of the "Ctenophores" is increased by ultraviolet light while the red rays extinguish it immediately.

2. On the contrary to the above mentioned the light of the "Meduses" shines like a light substance, the phosphorescence of which is believed to be continually stimulated by radium and therefore cannot be extinguished by an exposure to red light.

The authors distinguish between phosphorescence and bioluminescence. In the latter the animal can emit light in complete darkness without stimulation from any source of light but usually after some other form of stimulation including mechanical irritation.

Diabetic Neuritis. Charles D. Aring.

Ohio State M. J. **37**:941 (Oct.) 1941.

It has long been known that the longer the duration of imperfectly controlled diabetes, the more frequent is the involvement of the nervous system. However, control of the diabetes does not appreciably influence the course of the neuritis, once it has occurred.

The use of heat delivered by an electric pad or by warm baths is the single most useful agent in the relief of pain.

Weakness and pain may result from the pressure of bed clothes. A cradle should keep this weight off of the legs and feet. If paralysis is present the limb must be supported by padded splints in a neutral position. As for all forms of neuritis that cause weakness, bed exercises are a necessity after the period of extreme pain has passed, and even during this period if judiciously applied. The splints must be removed during these exercises. Gentle, passive movement of all joints of the involved limb is a requisite to prevent contracture and fixation. The patient should be encouraged to perform these movements several times a day. The severity of pain of the joints which results on passive movement, depends somewhat on the fixation that has developed, and it forms a rough index for the amount of physical therapy that is required. Obviously no interference with the mobility of joints should be allowed. Amateur massage of the muscles is unnecessary and likely to be harmful. If a skilled physical therapeutist is available the patient or his relatives might be instructed how to gently stroke and to kneed the muscles, the rigorousness of these maneuvers depending on the severity and stage of the disease. Massage and passive movement must be extremely gentle during the severe and early periods of neuritis.

A Splint to Increase Hip and Knee Motion. William J. Tobin.

J. Bone & Joint Surg. **23**:712 (July) 1941.

The splint described is a modification of the half-ring leg splint. The main feature of the modified splint is the maximum degree of hip and knee motion that is possible with its use. It is also of value in knee cases, since any method that increases hip flexion obviously increases knee flexion.

The Use of Surface Anesthesia in the Treatment of Painful Motion. Hans Kraus.

J. A. M. A. **116**:2582 (June 7) 1941.

The author describes a method of treatment for impaired function when pain is the factor responsible for the loss of motion or power. The treatment is the application of a surface anesthetic (ethyl chloride spray) combined with active motion.

As compared with the injection of procaine hydrochloride into the muscles and ligaments (Leriche), this method shows the following advantages: 1. Application is simpler. 2. Repeated application is possible, with less difficulty and risk. 3. Large areas can be controlled which otherwis would call for the use of vast quantities of procaine hydrochloride. 4. It does not work when fractures or tears are present; thus it is less

dangerous and more selective. 5. It is more advantageous in its use as a diagnostic means, being more selective. 6. There is less risk of a local after-effect and no general after-effect such as is sometimes seen after the administration of procaine hydrochloride. 7. There is no danger of infection.

The Early Use of Physical Therapy in the Treatment of Injury. Its Role in Minimizing the Need for Late Rehabilitation Measures. Clay Ray Murray.

New York State J. Med. **41**:1052 (May 15) 1941.

There is not enough definite information available as to the total physiologic effects of the various so-called modalities of physical therapy. There is still too much vague and indefinite quasi information cited in support of hoped-for physiologic effects.

From my own experience and that of others over a good many years, I have been convinced that elevation, gentle stroking, sedative massage, low-degree heat for prolonged periods, guided and resisted active exercise when it can be accomplished without pain, and muscular activity by electrical stimulation providing rhythmic, slow, alternating muscular contractions and relaxations without either spasm or pain will produce the desired effects. Likewise, heavy massage causing discomfort, intense heat for short periods, active exercise resulting in pain or spasm, and electrical stimulation giving muscular spasm or pain result in aggravation of the conditions for the relief of which they are given. Regarding diathermy, for the moment merely as a method of applying heat, high milliamperages for short periods belong in the latter group and low milliamperages for prolonged periods belong in the beneficial group. Therapeutic lamps giving intense heat for short periods do not help, while the low heat of two or three ordinary light bulbs inside a blanket tent over a period of hours is a definite benefit.

It is particularly in fracture cases that this early use of physical therapy is deprecated, yet it is in these cases that it is particularly valuable. True enough, its early use in these cases necessitates the employment of methods for treating the fracture which will allow ready access to the part for the use of physical therapy, and these methods are sometimes more difficult to carry out than other simpler methods that bar ready access to the affected regions.

Weather and Resistance in Pulmonary Tuberculosis. Part II. W. F. Petersen; J. S. Howe, and M. E. Milliken.

Am. Rev. Tuberc. **44**:548 (Nov.) 1941.

Of all the clinical phenomena observed in the progression of tuberculous disease in the human, the recognition of the seasonal activation of the disease (evident in the usual clinical findings, in complications and finally in death) is most ancient, as well as universally accepted.

For the patient who has established a modus vivendi it is the late winter and spring that is often associated with renewed signs of activation (tuberculin reaction, loss of weight, increase of fever, leucocyte count and sputum output, etc.). This particular study is primarily concerned with the examination of this phenomenon.

By season we merely express the sum total of continued weather effects. When we broadly consider weather effectors as they concern the human we think largely in terms of the energy requirements for adjustment. Here the frequency of the change, the relative degree of change, the extremes involved, are all of significance. For purposes of simplicity we have limited the consideration largely to the effect of cold.

With every energy impact (we are here limited to the consideration of weather effects, but all extraneous changes affecting the body must be considered) initiating such biological pendulation, the clinical outcome will depend on the net result, that is, on the attainment of a biological milieu of greater anabolic potential (beneficial) or greater catabolic potential (that is, harmful). Here obviously the available reserves (foodstuffs, vitamins, buffers, endocrines, etc., as well as the local cellular situation) will provide the background and condition the ultimate resuult.

An Investigation of Chemical Temperature Regulation. Allan Hemingway, and Starke R. Hathaway.

Am. J. Physiol. **134**:596 (Oct. 1) 1941.

Chemical regulation of temperature is defined by the authors as the increase in metabolic rate above the basal value when a resting and fasted animal is exposed to cold. There are two possible components of chemical temperature regulation, (1) an increase of metabolism without shivering, and presumably due to hormones which stimulate energy metabolism and (2) shivering.

The oxygen consumption rate and CO_2 production of 3 trained dogs have been measured while the animals were slowly cooled in an electrically shielded metabolism chamber. The onset of shivering was noted by electrical, mechanical and visual methods. In the electrical method the action currents were picked up by small skin electrodes placed over shivering muscles. The action potentials were amplified and made to operate a loud speaker, a cathode ray oscilloscope and a recording electronic integrator. On cooling before shivering started there was an average increase of metabolic rate of 7 per cent over basal. During the first twenty minutes of shivering the increase over basal was 30 per cent. These results indicate that the increase of metabolic rate without shivering has little effect in combating exposure to cold.